WILDERNESS & ENVIRONMENTAL MEDICINE 2022; 33(3): 284–9

ORIGINAL RESEARCH

Eye Injuries Caused by Wooden Projectiles in Finland

Anna-Kaisa Haavisto, MD, PhD[1]; Ahmad Sahraravand, MD[1]; Päivi Puska, MD, PhD[1]; Tiina Leivo, MD, PhD[1]

[1]*University of Helsinki and Helsinki University Eye Hospital, Helsinki, Finland*

Introduction—Eye injuries can cause decreased vision or even blindness, and predispose to future complications. Wood as an independent cause of eye injuries has infrequently been the focus of the studies. The aim of this study is to report the current population-based epidemiology, treatment, use of resources and outcomes of eye injuries caused by sticks, branches, and other wooden projectiles in Finland.

Methods—The study included all patients injured by wooden projectiles with ocular or orbital traumas over a 1-y period. Patients were treated at the Helsinki University eye hospital, which covers a population of 1.5 million. The follow-up time was 3 mo.

Results—Wooden projectiles caused 67 eye injuries and compromised 6% of all eye traumas during 1 y. Of the patients, males predominated (76%) and 22% were children under 17 y. Injury was most likely in spring (36%) and in males aged 51 to 67 y. The most common activity to cause injury was playing (27%), but in relation to time spent in each activity, the highest risk for eye injury was in gardening. Diagnoses were mild superficial trauma (54%), blunt ocular trauma (37%), eyelid wound (4%), orbital fracture (3%), and open globe trauma (1%). Permanent disability was estimated for 10% and a need for lifelong follow-up was estimated for 37%. Eleven patients needed major surgeries.

Conclusions—Wooden projectiles often cause serious eye injuries, permanent disability, and a need for lifelong follow-up. Caution is required to protect the eyes when playing with sticks and during gardening, forest work, and woodwork.

Keywords: ophthalmology, prevention, visual acuity, gardening, forest, play

Introduction

Wood as an independent cause of eye injury has rarely been the sole focus of studies. However, we know that among children sticks cause 7 to 27 % of eye traumas in Finland, 12% in Brazil, and up to 27% in Nigeria.[1-3] In Denmark, 33% of children's penetrating eye traumas, 4% in adults in Finland, and 6% in Canada have arisen from wooden items.[4-6] Among geriatric patients, wood strike was the most common reason for penetrating eye trauma in Turkey.[7]

Wooden material causing eye and intraorbital injuries have varied from branches and sticks to pencils, bamboo sticks, and corn stalks in previous studies.[4,8-10] As an organic material, untreated wood entails a risk for serious infections. Case reports are published on intraorbital, intraocular, and surface infections from uncommon bacteria and fungi.[10-12] On the other hand, in a few larger studies, no particular type of organism predominated and no mycobacteria or fungi were found.[8,9]

The purpose of this study was to provide an overview of the types of eye injuries wood causes.

Methods

The study includes all eye trauma patients injured by wooden items, for example, sticks and branches, who were taken into care at the emergency clinic of Helsinki University eye hospital (HUEH) over a 1-y period from May 1, 2011, to April 30, 2012. The HUEH is the sole tertiary and secondary eye care hospital in the area, covering a population base of 1.5 million. Patients injured by wooden dust, cosmetic wooden items, and matchsticks were excluded from the study. The study

Corresponding author: Anna-Kaisa Haavisto, P.O. Box 220, 00290 Helsinki, Finland; e-mail: anna-kaisa.haavisto@hus.fi.

Submitted for publication September 2021.

Accepted for publication March 2022.

https://doi.org/10.1016/j.wem.2022.03.008

protocol was approved by the local ethics committee of the Helsinki-Uusimaa hospital district and followed the tenets of the Declaration of Helsinki.

Patients were first prospectively identified in the emergency clinic and requested to fill out the questionnaire. Secondly, to obtain full coverage of the data the hospital records were accessed and ICD-10 diagnoses indicating eye injury were searched from hospital records to find missed patients. The case history of all patients was examined and the accuracy of the injury details were confirmed. From all patients (n=1151), patients injured by wooden projectiles were selected for this substudy.

A patient questionnaire inquired about the circumstances and causes of the accident, use of protective eyewear, influence of alcohol, and whether the injury was intentional. Informed consent was obtained from patients or their caregivers. In the absence of the questionnaire (n=28), the same information was gathered from the hospital records. Additional information, including the involved eye, age, sex, possible amblyopia, detailed clinical findings structurized by anatomic site and finding type, diagnoses, treatments, use of resources, sick leave days, and activity restrictions were recorded for all patients from hospital records. The follow-up time was 3 mo. The record from the last visit included the final visual acuity (VA), intraocular pressure (IOP), and significant symptoms and clinical findings.

Severity of the eye trauma was evaluated by estimating the need for lifelong follow-up, by performed surgery and estimated future surgery, and by permanent disability due to abnormal VA (<0.5 Snellen equivalent) or other functional symptoms.

Eye traumas were divided into 5 primary diagnosis groups: "blunt ocular trauma," "wound" referring to wound in eyelid or periorbital area, "orbital fracture," "open globe trauma" or group "other" referring to mild superficial trauma in the eye or periorbital area. Clinically, the most significant ocular trauma or the one needing most health care resources was chosen as the primary diagnosis. Possible secondary and tertiary diagnoses were recorded. In cases of binocular eye injury, the more seriously injured eye was selected. The energy of the trauma was evaluated as high-energy, if tools or falling was involved.

Resource use was estimated by the number of outpatient visits, duration of hospitalization and medication, number of operations performed, and need for sick leave or activity restriction. If sick leave or sports restriction was not recorded, the need for these was estimated based on clinical findings and international recommendations.[13-16] Where averages were determined, results were noted as mean±SD (range).

Activity during the accident was categorized into gardening, forest work, play, outdoor recreation, woodwork, or in different sports. Woodwork referred to working with wood as a hobby or at work. Forest work was chosen when the trauma took place during silviculture work, eg, harvesting wood and planting. Data on alcohol use and relation to work or assault was collected.

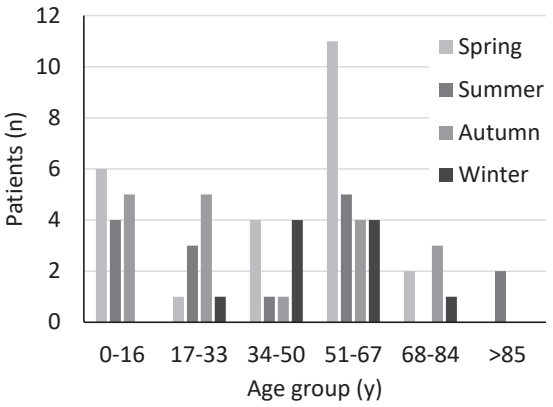

Figure 1. Age and seasonal variation of patients injured by wooden projectiles.

The incidence rates of eye injuries in each activity were calculated by dividing the number of accidents by the total population time spent in each activity in the HUEH area. The time spent in each activity was obtained from a Finnish time use study on forest activities,[17] and from a Finnish time use survey from Statistical Finland PX-web statistical database. Confidence intervals of 95% were calculated by exact method and used for statistical analysis of gardening, forest work, woodwork, outdoor recreation, cycling, skiing and orienteering. Data were available for people over 10 y of age.

Because some activities are seasonal in Finland, the year was divided into 4 seasons: spring (March, April, May), summer (June, July August), autumn (September, October, November) and winter (December, January, February). Epidemiological data were analyzed, distributions presented, and percentages calculated from the reported results.

Results

Wooden projectiles caused 67 eye traumas, which is 6% of all eye traumas treated at HUEH in a 1-y period. Of the patients, 76% (n=51) were males and 22% (n=15) were children under the age of 17 y. The incidence was 4.4 /100,000 population.[18] An eye injury was most likely in males aged between 51 and 67 y (n=24) (Figure 1). Two patients were lost to follow-up.

The injury was equally common in the left and right eye. No binocular traumas or traumas in an amblyopic eye were identified.

Table 1. Primary diagnoses, permanent disability, and need for lifelong follow-up caused by wooden projectiles in relation to activity. Eleven patients had significant secondary diagnoses

	All	*BOT*	*Wound*	*Fracture*	*OGT*	*Other*	*Permanent disability*	*Need for lifelong follow-up*
Play	18 (27%)[a]	7	2	–	–	9	–	7 (39%)[b]
Gardening	12 (18%)[a]	4	–	–	1	7	1 (8%)[b]	5 (42%)[b]
Forest work	11 (16%)[a]	6	1	–	–	4	1 (9%)[b]	5 (45%)[b]
Outdoor recreation	8 (12%)[a]	1	–	–	–	7	1 (13%)[b]	1 (13%)[b]
Woodwork	6 (9%)[a]	5	–	–	–	1	1 (17%)[b]	5 (83%)[b]
Sport	3 (4%)[a]	–	–	2	–	1	1 (33%)[b]	–
Unknown/Other	9 (13%)[a]	2	–	–	–	7	2 (22%)[b]	2 (22%)[b]
Total	67	25	3	2	1	36	7 (10%)	25 (37%)
Work-related	4 (6%)[a]	3	–	–	–	1	–	3
High-energy	15 (22%)[a]	9	1	1	1	3	5	10

BOT, blunt ocular trauma; OGT, open globe trauma; other, mild superficial trauma in the eye or periorbital area.
[a]Percentage calculated from the total number of eye injuries (n=67).
[b]Percentage calculated from the number of activities.

More injuries occurred during spring (36%) and autumn (27%) (Figure 1). Accidents took place at home (55%, 93% outside the house), at outdoor sites (12%), at school or day care (10%) and at work sites (8%). Data were not available for 16 patients.

There were no known intentional traumas. Alcohol was involved in 3 injuries of males aged 25-26 y. Protective eyewear was used by 1 patient while working with a table saw.

ACTIVITIES

The most common activities were playing (27%, n=18), gardening (18%, n=12) and forest work (16%, n=11) (Table 1). The activity could not be determined in 9 cases. Children were injured during play (n=14) and gardening (n=1). At play, the accidents took place when someone threw (n=4), a child swung (n=4) or someone hacked (n=2) a stick, while climbing in trees (n=2) or while kickboarding (n=1). In 1 patient, a keratitis scar remained in the cornea. Bacterial, fungal and viral cultures were negative.

While gardening, an 87-y-old male fell and was diagnosed with open globe trauma and orbital fracture. Eventually, the eye was eviscerated. Other gardening traumas were caused by a hit from a branch.

In forest work, 3 patients were using an axe, 1 a billhook, and 1 a saw. In outdoor recreation, 1 trauma was caused by stumbling in the woods and others were hits from branches. During the woodwork working with table or circular saw (n=3), axe (n=1), poking a window tab (n=1), and building a fence for horses (n=1) caused eye injuries. In sport, injuries were caused by a crash on a bike and in orienteering and skiing by a hit from a branch.

High energy was involved in 15 injuries (22%) (Table 1). All were adults, with males predominating (n=13, 87%). Tools were used in 11 cases and falling was a mechanism in 4.

When comparing the number of eye traumas in relation to time used for activity, the risk was highest in gardening, followed by forest work and woodwork (Table 2).

DIAGNOSES, TREATMENT AND USE OF RESOURCES

The most common primary diagnoses were superficial bulbar or periorbital trauma (n=36, 54%) and blunt ocular trauma (n=25, 37%) (Table 1). Clinically significant secondary diagnoses were reported for 16% of patients (n=11).

Major surgeries were needed for 10 patients (15%). One patient, probably in need of orbital surgery, was lost to follow-up. High energy was involved in 4 cases. Five patients were predicted to need surgery in the future. All injuries involved tools or falling.

The number of outpatient visits was 167 (2.5±2.4 [1−12] / 67 patients), hospitalization days 30 (3.3±3.1 [1−9 d] / 9 patients), and sick-leave days 405 (10.4±13.6 [1−54 d] / 40 patients) for patients aged over 16 y. Medication was needed for a total of 983 d (16.4±2,2 [3−90]) for 60 patients, 2 for elevated IOP.

THREE-MONTH FOLLOW-UP, PERMANENT DISABILITY, NEED FOR LIFELONG FOLLOW-UP

VA was lowered (0.5 Snellen equivalent or less) in 4 patients. Three months after the accident, 2 patients were medicated for elevated IOP.

Table 2. Risk for eye injury caused by wooden projectiles in different activities in relation to time spent in each activity. The time period was 1 y

Activity	*IR*[a]	*(95% CI)*
Gardening	10.70	(5.53–18.69)
Forest work	8.84	(4.41–15.81)
Woodwork	4.94	(1.81–10.76)
Outdoor recreation	2.40	(1.04–4.73)
Orienteering[b]	1.76	(0.04–9.80)
Cycling[b]	0.89	(0.02–4.97)
Skiing[b]	0.72	(0.02–3.98)

CI, confidence interval.
[a]Per 10,000,000.
[b]Included 1 patient.

Permanent disability was predicted for 7 patients (10%) because of lowered VA (n=3) due to retinal ablation, cataract, and subluxation of artificial lens, diplopia (n=2), evisceration (n=1), and glare due to mydriasis (n=1). Activities were various. High energy was involved in 5 cases. Tools were used in 2 cases, in forest work and woodwork. No children under the age of 17 y had a permanent disability (Table 1).

The need for lifelong follow-up was predicted for 25 patients (37%) because of elevated glaucoma risk (n=24) and evisceration (n=1). The most common activities were playing, gardening, forest work, and woodwork. High energy was involved in 10 cases. Tools were used in 7 cases, in forest work and woodwork-caused injuries. Six patients were children under the age of 17 y.

Discussion

This study presents a wide variation of eye injuries caused by wooden projectiles. We present a comprehensive population-based longitudinal study over a 1-y period from southern Finland. In this study, we analyzed the outcome of wooden projectile-caused eye injuries in relation to cause in urban and rural areas of southern Finland.

Interestingly, we found that spring was the most common season for wooden projectile eye injuries. Longer daylight in spring in Finland increases the possibility and enthusiasm for outdoor activities and also increases the time spent in gardens.

In our study, an eye injury was most common in males aged 51 to 64 y. Patients were older than in previous studies.[8,9] In Finland, older men seem to be in the greatest danger; they may be more active participants in forest work and gardening.

Playing, gardening, and forest work were the most common activities. In previous study forest work, assault and falling were the most common activities causing intraorbital wooden foreign bodies.[9] Compared with our study, there were no assaults, but falling was involved in 4 cases.

In relation to time spent in each activity, gardening, forest work, and woodwork were estimated to include the biggest risk for eye injuries. The use of tools possibly explains the increased risk in woodwork and in forest work. In gardening, only 1 patient used a tool (wood chipper) and another fell. The short working distance to branches may increase the risk for eye injuries. Also, the use of protective eyewear is not routine. Since comparable data for statistical analysis was available for people over 10 y of age and 12 out of 18 patients injured during playing were younger than 10 y, playing was not analyzed.

Permanent disability and need for lifelong follow-up were caused by various activities, but not by playing. The need for lifelong follow-up was not related to high-energy traumas only and also involved children. In 2 cases of severe blunt ocular traumas, the activity could not be defined.

A special interest in previous studies has been in intraorbital wooden foreign bodies. The incidence for these is rare, studies focus on case reports, and in our study only 1 patient had an intraorbital wooden foreign body.[8-10] A challenge in wood-induced eye traumas is the difficulty in identifying wood in radiological imaging. This may delay diagnosis and treatment.[10,12,18-22] Also, in our study, the radiological finding was reported as "air in intraorbital space," but since wood was suspected the report was corrected.

In our study, only 1 case of keratitis was diagnosed. Several reports of infections caused by wooden materials exist.[10] In many cases, the diagnosis was delayed, with the wooden intraorbital or intraocular foreign body identified only after infection.[8,9,11,12] However, the incidence of wood-associated orbital or ocular infections or keratitis has not been reported. According to our study, bacterial infections are rare.

Playing is essential for children and playing with sticks is ubiquitous. Playing should not be restricted excessively, but care should be taken when playing with sticks. Fortunately, playing with sticks did not cause any permanent disabilities. Nevertheless, 7 children need lifelong follow-up because of an elevated risk for glaucoma.[23-24]

Contrary to expectation, despite the use of protective eyewear, 1 eye injury took place while working with a table saw. The use of eye protection would likely have prevented or diminished eye injuries in woodwork and forest work, activities in which tools are commonly used. In addition, some accidents occurred unexpectedly in activities where eye protection is not generally an issue.

More attention should thus be focused on eye injuries when working with tools or in forestry.

Hospitalization, outpatient visits, and medication induce costs for society as direct health care costs. Indirect costs such as loss of income due to sick-leave, home care, and travel costs remains the burden of the individual. Preventing eye morbidity, the economic burden used for eye injury treatment could be aimed for other purposes. Further studies are needed to estimate the real costs of eye injuries.

Limitations

A few limitations are noteworthy. Firstly, the number of patients is relatively small for statistical analysis. Secondly, the short follow-up may affect the evaluation of permanent disability. A longer follow-up would likely have a positive impact since VA may improve after treatment and diplopia may slightly diminish over time.[25] In our study, diplopia in 1 patient may decrease over time and operating traumatic cataract probably improves VA. However, obvious disabilities, such as eviscerated eye and glare due to traumatic dilatated pupil can be seen in the 3-mo follow-up.

Conclusions

Our study shows that wooden projectiles cause various eye injuries in a wide range of circumstances, resulting in permanent disability and need for lifelong follow-up for many patients, including children. Most of these injuries are preventable and more attention should be directed to use of eye protection, especially during gardening, forest work, and woodwork. Children should be guided in playing safely with sticks.

Acknowledgments: This article is dedicated to our late coauthor Professor Juha Holopainen.

Author Contributions: Study concept and design (AKH, AS, TL); data analysis (AKH, AH, PP, TL); drafting and critical revision of the manuscript (AKH, AH, PP, TL); approval of the manuscript (AKH, AH, PP, TL).

Financial/Material Support: This study was supported by grants from the Evald and Hilda Nissi Foundation, the Mary and George C. Ehrnrooth Foundation, the Finnish Ophthalmological Foundation, and the Finnish Eye and Tissue Bank Foundation.

Disclosures: None.

References

1. Okpala NE, Umeh RE, Onwasigwe EN. Eye injuries among primary school children in Enugu, Nigeria: rural vs urban. *Ophthalmol Eye Dis*. 2015;7:13–9.
2. Rohr JT, Santos PM, Santos RC, Vieira CV, Fé LM, Solano RL, et al. Profile of pediatric eye trauma at Hospital de Base do Distrito Federal (HBDF), Brasília, Brazil. *Rev Assoc Med Bras (1992)*. 2016;62(4):324–9.
3. Haavisto AK, Sahraravand A, Holopainen JM, Leivo T. Paediatric eye injuries in Finland—Helsinki eye trauma study. *Acta Ophthalmol*. 2017;95(4):392–9.
4. Saunte JP, Saunte ME. Childhood ocular trauma in the Copenhagen area from 1998 to 2003: eye injuries caused by airsoft guns are twice as common as firework-related injuries. *Acta Ophthalmol*. 2008;86(3):345–7.
5. Gordon KD. The incidence of eye injuries in Canada. *Can J Ophthalmol*. 2012;47(4):351–3.
6. Sahraravand A, Haavisto A, Holopainen JM, Leivo T. Ocular traumas in working age adults in Finland—Helsinki ocular trauma study. *Acta Ophthalmol*. 2017;95(3):288–94.
7. Yüksel H, Türkcü FM, Çınar Y, Cingü AK, Sahin A, Sahin M, et al. Etiology and prognosis of penetrating eye injuries in geriatric patients in the southeastern region of Anatolia Turkey. *Ulus Travma Acil Cerrahi Derg*. 2014;20(4):253–7.
8. Shelsta HN, Bilyk JR, Rubin PA, Penne RB, Carrasco JR. Wooden intraorbital foreign body injuries: clinical characteristics and outcomes of 23 patients. *Ophthal Plast Reconstr Surg*. 2010;26(4):238–44.
9. Taş S, Top H. Intraorbital wooden foreign body: clinical analysis of 32 cases, a 10-year experience. *Ulus Travma Acil Cerrahi Derg*. 2014;20(1):51–5.
10. Li J, Zhou LP, Jin J, Yuan HF. Clinical diagnosis and treatment of intraorbital wooden foreign bodies. *Chin J Traumatol*. 2016;19(6):322–5.
11. Chew HF, Jungkind DL, Mah DY, Raber IM, Toll AD, Tokarczyk MJ, et al. Post-traumatic fungal keratitis caused by Carpoligna sp. *Cornea*. 2010;29(4):449–52.
12. Clark JD, Fernandez de Castro JP, Compton C, Lee H, Nunery W. Orbital cellulitis and corneal ulcer due to Cedecea: first reported case and review of the literature. *Orbit*. 2016;35(3):140–3.
13. Recchia FM, Saluja RK, Hammel K, Jeffers JB. Outpatient management of traumatic microhyphema. *Ophthalmology*. 2002;109(8):1465–70.
14. Walton W, Von Hagen S, Grigorian R, Zarbin M. Management of traumatic hyphema. *Surv Ophthalmol*. 2002;47(4):297–334.
15. Gerstenblith AT, Rabinowitz MP. *Wills Eye Manual: Office and Emergency Room Diagnosis and Treatment of Eye Disease*. 6th ed. Philadelphia, PA: LWW; 2009.
16. Tsai J, Denniston A, Murray P, Huang J, Aldad T. *Oxford American Handbook of Ophthalmology*. Cary: Oxford University Press; 2011.
17. Saastamoinen O, Vaara M. Small-scale forest related activities in the everyday life of the Finns: results of time-budget studies. *Small-Scale Forestry*. 2009;8(4):425–45.
18. Specht CS, Varga JH, Jalali MM, Edelstein JP. Orbitocranial wooden foreign body diagnosed by magnetic resonance imaging. Dry wood can be isodense with air and orbital fat by computed tomography. *Surv Ophthalmol*. 1992;36(5):341–4.
19. Fulcher TP, McNab AA, Sullivan TJ. Clinical features and management of intraorbital foreign bodies. *Ophthalmology*. 2002;109(3):494–500.
20. Kim UR, Sivaraman KR. Penetrating orbital injuries from plant material during pond and river diving. *Indian J Ophthalmol*. 2013;61(2):76–7.
21. Desai A, Parihar R, Mathews J, Akduman L. Occult wooden posterior segment intraocular foreign body. *Ophthalmic Surg Lasers Imaging Retina*. 2014;45(1):58–61.

22. Liu M, Xin X, Li J, Chen S. The first case of endophthalmitis due to Rhinocladiella basitona in an immunocompetent patient. *Diagn Microbiol Infect Dis*. 2015;83(1):49–52.
23. Girkin C, McGwin Jr G, Long C, Morris R, Kuhn F. Glaucoma after ocular contusion: a cohort study of the United States eye injury registry. *J Glaucoma*. 2005;14(6):470–3.
24. Kaufman JH, Tolpin DW. Glaucoma after traumatic angle recession: a ten-year prospective study. *Am J Ophthalmol*. 1974;78(4):648–54.
25. Murray AD. An approach to some aspects of strabismus from ocular and orbital trauma. *Middle East Afr J Ophthalmol*. 2015;22(3):312–9.