

SCIENTIFIC CORRESPONDENCE

Relation of ocular trauma to cortical, nuclear, and posterior subcapsular cataracts: the Beaver Dam Eye Study

T Y Wong, B E K Klein, R Klein, S C Tomany

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Background: The consequences of minor ocular trauma in the general population are unclear. The relation of self reported ocular trauma to cortical, nuclear, and posterior subcapsular cataracts is described in a defined population.

Methods: Population based, cross sectional study involving all people aged 43 to 86 years, living in Beaver Dam, Wisconsin (n=4926). Ocular trauma was ascertained by interview and cataract was graded from lens photographs. The relation of ocular trauma to cortical, nuclear, and posterior subcapsular cataracts was examined.

Results: People with a history of ocular trauma were more likely to have cortical (odds ratio (OR): 1.5; 95% confidence interval (CI): 1.0 to 2.2) and posterior subcapsular (OR: 1.7; 95% CI: 1.0 to 3.1) cataracts, compared to people without a history of trauma. These associations were stronger for people with previous trauma caused by a blunt object (OR: 3.3; 95% CI: 1.6 to 6.9 for cortical cataract, and OR: 4.1; 95% CI: 1.5 to 10.8 for posterior subcapsular cataracts). However, in analyses comparing the frequencies of cataract between traumatised and non-traumatised eyes among people with unilateral ocular trauma, the ocular trauma association for cortical cataract was no longer present, although the association for posterior subcapsular cataract persisted (OR: 2.4; 95% CI: 0.8 to 7.8).

Conclusion: The data provide evidence of a possible association between self reported ocular trauma and posterior subcapsular cataract.

In this study, we describe the association of self reported ocular trauma with cortical, nuclear, and posterior subcapsular cataracts in a defined white adult population aged 43–86 years.

METHODS

Study population

The Beaver Dam Eye Study is a population based survey of age related ocular diseases, with its population, research methodology, and findings described in detail in other reports.⁹ In brief, a private census of the population of Beaver Dam, Wisconsin, was performed from autumn 1987 to the end of spring 1988. All 5924 people who were 43–86 years of age identified as living in the township were eligible, and were invited to participate in the study from spring 1988 to the end of autumn 1990. Of eligible people, 4926 participated. Comparisons between participants and non-participants have been presented elsewhere.⁹

Definition of ocular trauma

All participants had a standardised interview that included questions on ocular trauma.² During the interview, participants were asked the following question relating to ocular trauma, "Have you ever had any injury to either eye requiring a doctor's care?" with the following five possible responses: no; yes, right eye only; yes, left eye only; yes, both eyes; yes, not sure which eye. A history of ocular trauma caused by a blunt object was further defined as a positive response to the question "Was this due to being hit by a blunt object like a fist or a ball?"

Definition of cortical, nuclear, and posterior subcapsular cataracts

For the evaluation of cataracts, photographs were taken of the lens after pupil dilatation, and graded for the presence and severity of cataract.¹⁰ The grading procedure was based on detailed codified decision rules, by graders masked as to subject identity and characteristics, including whether the participant had reported previous ocular trauma. Scores for nuclear sclerosis were based on comparisons with standard photographs that included a five step level of severity based on opacity of the nucleus.¹¹ Scores for cortical and posterior subcapsular cataracts were based on weighted estimates of degree of opacity of lens area as defined by a circular grid, divided into eight "pie wedged" peripheral areas and a central circular area.¹¹

The definitions of respective cataracts were: nuclear sclerosis levels four or more, and cortical and posterior subcapsular opacities involving 5% or more of the visible lens.¹¹ In general, overall reproducibility was good and was similar for inter-grader and intragrader comparisons.¹¹

Ocular trauma is a common, but preventable disease.¹ Approximately one in five adults report a history of ocular trauma in their lifetime, although less than 2% have trauma severe enough to warrant hospitalisation.² While severe ocular trauma is associated with a variety of blinding complications,^{3,4} the consequences of less severe trauma are not clear.¹ Minor ocular trauma has been reported to cause subclinical angle recession,⁵ trabecular damage,⁶ and other anterior segment problems.⁷

Atrophy of the lens and dust-like opacities have been described following minor blunt ocular trauma with no evidence of capsule rupture, long after the initial injury episode.⁸ These lenticular changes may be related to absorption of the lens matter and/or disturbance in the growth of new lens fibres from epithelial damage. The changes have been further suggested to increase the risk of cataract that are typically seen with ageing (that is, cortical, nuclear, and posterior subcapsular cataracts) later in life.⁸ However, few data are available regarding a possible relation between ocular trauma and these types of cataract in the general population.

Table 1 Baseline characteristics of people by ocular trauma status

	Number (%) of ocular trauma					p Value
	No trauma	Trauma				
		Both eyes	Right eye only	Left eye only	Unspecified eye	
Age						
43–54	1141 (29.0)	75 (50.0)	115 (38.9)	80 (29.6)	108 (42.2)	0.02*
55–64	1013 (25.7)	38 (25.3)	88 (29.7)	94 (34.8)	80 (31.3)	0.09†
65–74	1078 (27.4)	26 (17.3)	66 (22.3)	64 (23.7)	47 (18.1)	
75–86	708 (17.9)	11 (7.3)	27 (9.1)	32 (11.9)	21 (8.2)	
Sex						
Men	1458 (37.0)	133 (88.7)	213 (72.0)	174 (64.4)	182 (71.1)	<0.01*
Women	2479 (63.0)	17 (11.3)	83 (28.0)	96 (35.6)	74 (28.9)	0.11†
Smoking status						
Never	1869 (47.5)	35 (23.3)	93 (31.5)	96 (35.6)	100 (39.1)	0.02*
Previous	1328 (33.8)	70 (46.7)	125 (42.4)	109 (40.4)	111 (43.4)	0.13†
Current	738 (18.8)	45 (30.0)	77 (26.1)	65 (24.1)	45 (17.6)	
Diabetes						
No	3654 (92.9)	144 (96.0)	274 (92.6)	251 (93.0)	239 (93.4)	0.55*
Yes	280 (7.1)	6 (4.0)	22 (7.4)	19 (7.0)	17 (6.6)	0.94†
Cortical cataract, right eyes						
No	3161 (87.6)	129 (91.5)	241 (89.3)	230 (92.0)	231 (93.2)	0.45*
Yes	499 (12.4)	12 (8.5)	29 (10.7)	20 (8.0)	17 (6.8)	0.27†
Nuclear cataract, right eyes						
No	3105 (85.6)	133 (93.7)	248 (92.2)	229 (91.6)	227 (91.5)	0.88*
Yes	522 (14.4)	9 (6.3)	21 (7.8)	21 (8.4)	21 (8.5)	0.96†
Posterior subcapsular cataract, right eyes						
No	3473 (96.9)	137 (97.4)	253 (95.1)	243 (96.4)	240 (97.6)	0.37*
Yes	110 (3.1)	3 (2.6)	13 (4.9)	9 (3.6)	6 (2.4)	0.33†

*p Value comparing frequencies between trauma, both eyes; trauma, right eyes; trauma, left eyes; and trauma, unspecified eyes; †p value comparing frequencies between trauma, right eyes; trauma, left eyes; and trauma, unspecified eyes.

Statistical analysis

Initially, we used logistic regression to calculate the odds ratios for cataract comparing people with and without previous ocular trauma to their right eyes, adjusting for age and sex. These were repeated for left eyes separately. We also used generalised estimating equations (GEE) models to derive the adjusted odds ratios for cataract using information from both eyes simultaneously, while controlling for the correlation between the two eyes in the same individual.¹² Finally, we used the matched case-control design to compare the frequencies of cataracts between the traumatised and non-traumatised fellow eyes, in people with unilateral ocular trauma.

The tenets of the Declaration of Helsinki were followed, informed consent was obtained after the nature and possible consequences of the study were explained, and the institutional human experimentation committee approved the research.

RESULTS

Of the 4926 participants, 150 reported a history of ocular trauma to both eyes, 296 the right eye only, 270 the left eye only, and in 256 subjects the participant could not remember which eye was involved (unspecified eye). The age, sex, smoking status, diabetes status, and prevalence of different types of cataract in these subgroups are shown in Table 1. In general, people with a history of ocular trauma were younger, more likely to be men, and more likely to be previous or current smokers compared to people without a history of ocular trauma. People with and without trauma were similar with respect to diabetes status. The frequencies of cortical and nuclear cataract were lower, but the frequency of posterior subcapsular cataract was similar in people with ocular trauma compared to those without trauma.

For subsequent analyses, the 256 (5.2%) participants who were classified as having ocular trauma to an unspecified eye were excluded. The characteristics and prevalence of cataract in excluded people were not significantly different from those of included people with unilateral ocular trauma (right eye only and left eye only) (Table 1). The right eye was considered

to have sustained ocular trauma if trauma involved the right eye or both eyes, and the left eye was considered to have ocular trauma if trauma involved the left eye or both eyes. Thus, 446 people were defined to have previous ocular trauma to their right eyes and 420 to their left. For each analysis, we then excluded eyes with previous cataract surgery, ungradable lens, or lens opacity that was not explicitly “age related” (for example, congenital cataracts, pseudoexfoliation syndrome).¹¹ The proportion excluded was similar between people with and without ocular trauma. As an example, for cortical cataract, 35 (7.8%) were excluded from 466 with ocular trauma to the right eye, leaving 411 people for analysis. Similarly, 327 (8.3%) were excluded from 3937 without ocular trauma, leaving 3610 people for the same analysis.

Table 2 shows the frequencies of cataract in the right eye between people with and without trauma to their right eyes. The crude frequencies of cortical and nuclear cataracts were lower, but the frequency of posterior subcapsular cataract was similar, in right eyes with ocular trauma compared to right eyes without ocular trauma. After controlling for age and sex, people with a previous ocular trauma in their right eyes were significantly more likely to have cortical and posterior subcapsular cataracts in the right eyes, compared to people without previous trauma. The associations for cortical and posterior subcapsular cataract were stronger for previous ocular trauma caused by a blunt object. Similar results were obtained when analyses were repeated for left eyes, with further adjustment for diabetes and cigarette smoking, and when data from both eyes were combined using GEE models (not shown). For example, the GEE adjusted odds ratios for cortical and posterior subcapsular cataracts related to ocular trauma caused by a blunt object were 2.4 (95% confidence interval: 1.3 to 4.3) and 2.9 (95% confidence interval: 1.4 to 5.9), respectively.

Finally, Table 3 shows the results of the matched case control analyses in people with unilateral ocular trauma and lens data in both eyes. There were 566 people who could potentially contribute to this analysis (296 with trauma to the right eye only and 270 with trauma to the left eye only). For each type of cataract, we similarly excluded people if either eye did not

Table 2 Relation of cortical, nuclear, and posterior subcapsular cataract to ocular trauma, comparing people with trauma to those without trauma

	No of people*	Crude no (%) with cataract in right eyes	Adjusted OR (95% CI)†
Cortical cataract			
Any trauma to right eye	411	41 (10.0)	1.5 (1.0 to 2.2)
Trauma by blunt object to the right eye	62	11 (17.7)	3.3 (1.6 to 6.9)
No trauma	3610	449 (12.4)	1.0
Nuclear cataract			
Any trauma to right eye	411	30 (7.3)	1.0 (0.6 to 1.5)
Trauma by blunt object to the right eye	61	7 (11.5)	1.9 (0.8 to 4.9)
No trauma	3627	522 (14.4)	1.0
Posterior subcapsular cataract			
Any trauma to right eye	406	16 (3.9)	1.7 (1.0 to 3.1)
Trauma by blunt object to the right eye	61	5 (8.2)	4.1 (1.5 to 10.8)
No trauma	3583	110 (3.1)	1.0

*Number of people at risk varies slightly for each specific cataract type; †odds ratio adjusted for age and sex, comparing people with and without trauma.

Table 3 Relation of cortical, nuclear, and posterior subcapsular cataract to ocular trauma, comparing eyes with trauma and fellow eyes without trauma in people with unilateral ocular trauma

	No of people with unilateral trauma*	No (%) of eyes with cataract	Paired OR (95% CI)†
Cortical cataract	498		
Eyes with trauma		42 (8.4)	0.8 (0.3 to 1.7)
Fellow eyes without trauma		46 (9.2)	1.0
Nuclear cataract	491		
Eyes with trauma		38 (7.7)	1.4 (0.7 to 3.1)
Fellow eyes without trauma		32 (6.5)	1.0
Posterior subcapsular cataract	493		
Eyes with trauma		14 (2.8)	2.4 (0.8 to 8.7)
Fellow eyes without trauma		7 (1.4)	1.0

*Number of people at risk varies slightly for each specific cataract type; †based on paired odds ratio, comparing eyes with trauma and fellow eyes without trauma in the same person.

have usable lens data (that is, previous cataract surgery, ungradeable lens). For example, out of 566 people, 46 (8.1%) and 22 (3.9%) did not have usable lens data on the traumatised eye and non-traumatised fellow eye, respectively, leaving 498 people for the cortical cataract analysis. People excluded were not significantly different with respect to age, sex, smoking, and diabetes status (not shown). The frequency of posterior subcapsular cataract was higher in the traumatised compared to the non-traumatised fellow eye, although this relation was not significant (Table 3). The frequencies of cortical and nuclear cataracts were similar between the two eyes.

DISCUSSION

Although the acute and long term effects of severe ocular trauma are devastating,^{3,4} these forms of injury are fortunately uncommon in the general population.^{1,2} From a public health perspective, less severe ocular trauma is perhaps as important, because it is more prevalent and is potentially preventable.¹ The consequences of minor ocular trauma in the general population are not known. It has been suggested that even minor blunt trauma may increase the risk of subsequent cataract formation, based on early studies that show faster progression of lens changes in eyes with a history of trauma than in fellow eyes of the same individual.⁸

Our study was designed to investigate possible associations between previous self reported ocular trauma and cortical, nuclear, and posterior subcapsular cataracts. The crude frequencies of cataracts were either lower (cortical and nuclear) or no different (posterior subcapsular) in eyes with ocular trauma compared to eyes without trauma. However,

after controlling for age and sex, we showed that people who reported a history of ocular trauma were 50–70% more likely to have cortical and posterior subcapsular cataracts, compared to other people without ocular trauma. The change in the direction of the ocular trauma associations for cataract results largely from the strong confounding effects of age and sex on the unadjusted associations (that is, ocular trauma was more frequent in younger people and men, but cataract was more frequent in older people and women¹¹). The ocular trauma associations for cortical and posterior subcapsular cataracts were stronger for trauma reportedly caused by blunt objects, and were not altered after adjusting for other cataract risk factors. However, when the analyses were repeated comparing frequencies of cataract between traumatised and non-traumatised eyes among people with unilateral ocular trauma only (matched case-control approach), the association for cortical cataract was no longer present. The discrepancy may be the result of the exclusion of people with bilateral (and possibly more severe) ocular trauma, or it may simply indicate that any possible ocular trauma association with cortical cataract is weak. In contrast, the association for posterior subcapsular cataract persisted (although it was not statistically significant, possibly because of reduced sample size in the matched case-control approach). Thus, the data provide more consistent evidence of a possible association between ocular trauma and posterior subcapsular cataract.

There are few studies for direct comparison. Radiation injury from ultraviolet light has long been suggested to predispose the lens to the development of cortical cataract.^{13,14} Data on a possible relation between mechanical ocular trauma and cataract are lacking. In a population based survey in Australia, McCarty *et al* found no association between a history of

ocular trauma and cortical, nuclear, or posterior subcapsular cataracts.¹⁵

Study strengths include an unselected population, standardised interview for ocular trauma, and photographic documentation of cataract by graders masked to subject characteristics. Study limitations should also be highlighted. Firstly, ocular trauma was self reported. The data were not validated with an examination of medical records, the questions could be misinterpreted, and information on the nature (work or assault related) and the treatment received (medical or surgical) at the time of the injury episode was not available. Secondly, selection bias might have attenuated some of the associations, since people with aphakia and people with ocular trauma to an unspecified eye were excluded. However, this is not expected to be substantial, as the proportion and characteristics of people excluded appear similar to those included. Thirdly, it is possible that masking was incomplete in eyes with moderately significant trauma. Nevertheless, since the graders were not aware of the hypothesis of this study, the grading procedure was based on a detailed protocol, and the degree of lens opacity was quantified on an ordinal scale, the likelihood of bias due to incomplete masking is minimised. Finally, it should be noted that these analyses were cross sectional, although temporal bias (for example, cataract causing ocular trauma) is unlikely in this study.

In summary, we explored a possible relation between ocular trauma and cataract. Our results indicate a weak association between ocular trauma and posterior subcapsular cataract. Other studies with a more precise definition of ocular trauma and prospective follow up to determine risk of cataract may lead to more accurate estimates of these associations.

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Authors' affiliations

T Y Wong, B E K Klein, R Klein, S C Tomany, Department of Ophthalmology and Visual Sciences, University of Wisconsin, Madison, WI, USA

T Y Wong, Singapore National Eye Center and Department of Ophthalmology, National University of Singapore

Correspondence to: Tien Yin Wong, Department of Ophthalmology, National University of Singapore, 10 Kent Ridge Crescent, Singapore 119260; tienyinwong@yahoo.com

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