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Sport-related ocular trauma in Vancouver, British Columbia: Not the usual suspects

A remarkably high rate of badminton-induced eye injury was found in a retrospective chart review.

ABSTRACT

Background: **Vision loss due to eye injury has a significant effect on quality of life. In the US, trauma to the ocular structures is one of the most common causes of blindness, second only to cataracts, and 15% of these injuries occur during baseball, basketball, racquetball, football, and soccer activities. A study was proposed to establish the chief sporting causes of traumatic eye injury in Vancouver, BC, and to determine if individuals could be encouraged to use eye protection for high-risk sports.**

Methods: **The study was conducted using data for patients with ocular trauma referred to the Vancouver General Hospital Eye Care Centre in 2013. Sport-related cases were identified in a retrospective chart review and follow-up visits were arranged. Patient characteristics, cause of injury, visual function, and ocular diagnosis were analyzed. A subgroup of patients was surveyed to assess their attitudes toward the use of eye protection.**

Results: **Of 1301 charts reviewed, 58 were found to describe sport-related traumatic eye injuries (4.45%) sustained in 23 activities. The most common sports leading to injury were soccer and badminton. The majority of patients with badminton-induced injuries felt that eye protection would have prevented their injuries, yet only a minority agreed that the use of eye protection for the sport should be encouraged.**

Conclusions: **Soccer and badminton were the chief causes of sport-related injury seen at the Vancouver General Hospital Eye Care Centre in 2013. All badminton-induced injuries resulted in traumatic hyphema. Primary care physicians should be confident in managing minor ocular trauma but be aware of potential complications and not hesitate to contact an ophthalmologist should they have concerns. Mandating eye protection for youth, normalizing the use of protective eyewear, and educating those participating in high-risk sporting activities should be considered to reduce ocular trauma.**

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Background

Vision loss resulting from traumatic eye injury has a significant effect on quality of life in the developed world.[1] Trauma to the ocular structures is one of the most common causes of blindness in the US, second only to cataracts, and 15% of these injuries occur during sporting activities.[1] The most common activities related to traumatic eye injury in the US are baseball, basketball, racquetball, football, and soccer.[1]

Our clinical experience in Vancouver, BC, suggests that US sport-related injury findings do not apply to our patient population. A Canadian study found that the three most common locations for ocular injuries were the home, the workplace, and sporting activity sites.[2] While Canada has

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a similar proportion of sport-related eye injuries (8.6% of all traumatic eye injuries), it is unclear which sports are primarily responible.[2] Reports of previous studies have not provided details about type of sporting activity, presence of eye protection, type of eye protection used, if any, and attitudes toward eye protection.[2] Further research in this area could have important implications for injury prevention in Canada. Moreover, this is of particular concern in British Columbia, a province ranking in the top three for number of eye injury incidents based on recent survey results.[2]

We hypothesized that the unique demographics of Vancouver would mean some sports not identified in US studies are the primary cause of traumatic eye injuries. Our goal was to establish the chief sport-related causes of traumatic eye injury at our hospital, and to determine which sports participants were amenable to using eye protection.

Methods

Charts were reviewed for patients visiting the Vancouver General Hospital (VGH) Eye Care Centre from 1 January 2013 to 31 December 2013. All charts describing sport-related traumatic eye injury were identified and patients were contacted for follow-up.

Data collected and analyzed included patient age, sex, community of residence, ethnicity, and cause of injury (i.e., sport played). Visual function was assessed at each patient's follow-up visit to determine secondary complications related to hyphema, the accumulation of blood in the anterior chamber. Examination results for the affected eye versus the unaffected eye were compared for best corrected visual acuity (BCVA) and intraocular pressure (IOP) using paired sampled *t* tests. Significance was set at an alpha value of .05.

Six binary questions were answered by patients with badminton injuries to assess their attitude toward eye protection.

The principles of the Declaration of Helsinki were followed when designing and executing the study. Ethics approval was granted by the University of British Columbia's Clinical Research Ethics Board.

Results

Of 1301 charts reviewed, 58 described sport-related traumatic eye injuries (4.45%). The mean age of injured patients was 29.8 (SD 14.8) years. The youngest patient was 5 years old and the oldest was 64 years old. The male to female ratio was 2.1 to 1.0. The majority of injuries (35 of 58) occurred in the summer months.

Twenty-three sporting activities were identified and three or more injuries occurred in seven activities: soccer, badminton, cycling, squash, ball hockey, baseball, and rugby (**Table 1**). Soccer was the sport most commonly associated with eye trauma at the VGH Eye Care Centre in 2013, followed by badminton. Together these activities accounted for one-third of all ocular trauma seen at the centre. Traumatic hyphema was seen in all nine patients with badminton-induced injuries, and three of the nine patients had intraocular pressure rise. One had commotio retinae and vitreous hemorrhage and one had cystoid macular edema.

Of the nine patients with badminton-induced traumatic eye injury, most had evidence of angle recession on gonioscopy. Moreover, we observed a statistical impairment in both best corrected visual acuity ($P = .027$) and intraocular pressure ($P = .011$) in the affected eye compared with the unaffected eye (**Table 2**).

Table 1. Sporting activities resulting in traumatic eye injuries.

Activity	Number of patients
Soccer	12
Badminton	9
Cycling	5
Squash	4
Ball hockey	3
Baseball	3
Rugby	3
Frisbee	2
Hockey	2
Snowboarding	2
Boxing	1
Dodgeball	1
Fishing	1
Football	1
Golf	1
Inner tubing	1
Lacrosse	1
Longboarding	1
Martial arts	1
Mountain climbing	1
Polo	1
Underwater hockey	1
Volleyball	1

Table 2. Analysis of results for best corrected visual acuity (BCVA) and intraocular pressure (IOP) following badminton-induced traumatic eye injury.

Metric	Affected eye	Unaffected eye	*P*-value
BCVA (logMAR)	0.61	0.06	0.027
IOP (mm Hg)	20.6	13.1	0.011

logMAR = logarithm of the minimum angle

Five of the nine patients injured playing badminton responded to the survey questions. The majority believed eye protection could have prevented their injuries, yet only a minority agreed that the use of eye protection for the sport should be encouraged.

Conclusions

Results of this retrospective chart review suggest that the sports associated with ocular trauma in the Vancouver area differ from those reported in the US,[1] and that badminton is underrecognized as an activity associated with significant intraocular injury.

In 2013 badminton caused 15% of all sport-related traumatic eye injuries at the VGH Eye Care Centre and led to hyphema in 100% of cases. Other investigations have not identified badminton as a cause of traumatic eye injury, which may be due to the differences in sporting interests seen in Vancouver's ethnically diverse population.[1] The 2011 census found that approximately 40.1% of the population in Vancouver spoke a nonofficial language (i.e., not English or French) at home.[3] Badminton is a popular sport in Vancouver's large Asian community and three of the five survey respondents were of Asian ethnicity. Unlike squash, a similar racquet sport, badminton does not require the use of eye protection.

Understanding the risks posed by activities such as badminton and knowing more about the pathophysiology of ocular trauma and how to prevent and manage eye injuries can reduce vision loss and other complications.

Pathophysiology of ocular trauma

Trauma to the eye can range from adnexal abrasions and lacerations to blunt and penetrating orbital injury. Ocular trauma from sport is often the result of a blunt force that results in hyphema.[4] Although hyphemas are most commonly caused by trauma, they can also be caused by postoperative complications, iris neovascularization, melanoma, leukemia, and juvenile xanthogranuloma.[4]

Traumatic hyphemas occur when a blunt force indents and stretches the globe, resulting in architecture disruption and increased intraocular pressure. This intraocular pressure causes a posterior displacement of the lens-iris diaphragm and bleeding from disruption of the highly vascularized ciliary body and iris.[4] Although hyphema is usually a self-limiting condition, significant ocular trauma requires referral to an ophthalmologist for management and follow-up of secondary complications such as chronic elevation of intraocular pressure, blood deposition in the cornea, peripheral anterior synechiae, posterior synechiae, cataracts, and optic nerve damage.[5,6] Other posterior segment injuries that may occur as a result of trauma to the globe are commotio retinae, traumatic macular hole, choroidal rupture, vitreous hemorrhage, and traumatic retinal detachment or retinal dialysis.[7] These sequelae may ultimately result in reduced visual acuity or, in severe cases, blindness.

Injury prevention

Eye protection in sport is widespread and has a long history. Around 1200 BC the first use of a protective face mask for fencing was documented by the Egyptians.[8] Since then, many forms of eye protection have developed, including visors, goggles, and sunglasses. In many Olympic sports, eye protection is mandated to protect competitors from both external injuries such as corneal abrasion and internal injuries such as retinal detachment.[8] Some sporting organizations have mandated eye protection; examples include baseball catcher's masks, hockey visors, football visors, and squash goggles.[8] On 1 January 2012, US Squash, the national governing body for the sport, required protective eyewear to be worn during all events accredited by US Squash.[8,9] Squash is the first racquet sport to implement strict rules and regulations for eye protection. This was an instrumental move in the US and has reduced the number of sport-related ocular injuries.[1,2] Further, US Squash requires that eyewear meet the current

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ASTM (American Society for Testing and Materials) standards, a significant step ahead of what Canada has done regarding eye protection regulations.[9]

There is much room for improvement when it comes to eye protection for both soccer and badminton. Action needs to be taken on the international, national, and regional levels. At the international level, the Olympics can make eye protection mandatory. At the national level, governing bodies can require anyone using public facilities to wear eye protection. At the regional level, school boards and clubs can require all children competing in tournaments to wear eye protection. Moreover, individual coaches and parents can educate youth about eye protection benefits, including improved sport performance and prevention of vision loss. With children, the short-term benefits should be emphasized and the use of eye protection should be normalized to achieve higher adherence rates. Reaching athletes at the beginning of their sporting careers is likely to have the most long-term impact. Historically, prevention of injuries has been the key to reducing ocular trauma in sport and much can still be done in this regard.

Injury management

In primary care it is important to identify those patients who can be managed by general practitioners and those who should be referred to a specialist. This is particularly difficult if loss of vision is possible, as primary care physicians would rather err on the side of caution and make a referral. In cases of ocular trauma it is imperative to do a primary survey, obtain a thorough history, and complete a physical examination of the eye and surrounding ocular adnexa. History taking should focus on pertinent details regarding the mechanism of the traumatic event (blunt vs penetrating, monocular vs binocular), any vision loss (central vs peripheral), pain, visual distortion, or diplopia, and past instances of poor vision or other significant disorders (e.g., coagulopathies). The physical examination should include an assessment of visual acuity, external adnexa, ocular motility, and pupillary reaction, as well as confrontational field testing and fundoscopy. Medications such as anesthetic eye drops (e.g., tetracaine 0.5%) and cycloplegics (e.g., cyclopentolate 0.5%) for paralysis of the ciliary muscle may be needed for the physical examination, as patients with ocular trauma can be in significant pain and unable to cooperate. Fluorescein eye stain should be used to evaluate for corneal abrasions. Mydriatics (e.g., tropicamide 0.5%) can be used to facilitate fundoscopy, but should be avoided if there is a shallow anterior chamber or if the patient is under neurological observation.[10] Ocular trauma typically requires that therapy be instituted within a few hours.[10] Urgent referral (i.e., an ophthalmologist should be seen at once) is required for penetrating injuries of the globe, embedded conjunctival or corneal foreign bodies, hyphema, and traumatic optic neuropathy (usually in the context of cranial or maxillofacial trauma).[10] Semi-urgent referral (i.e., an ophthalmologist should be seen in 1 to 2 days) is indicated for orbital fractures and subconjunctival hemorrhage in the context of blunt trauma.[10] A thorough examination is required to ensure appropriate referral. Primary care physicians should be confident in managing minor ocular pathology but be aware of potential complications and not hesitate to contact an ophthalmologist should they have concerns.

Although there is limited evidence for managing uncomplicated traumatic hyphema, initial treatment should include conservative measures, rest, and eye protection.[11,12] Rest is the single most important step in the management of hyphema. Typically, patients with hyphema are prescribed bed rest for up to 10 days after ocular trauma to prevent rebleeding and its serious consequences.[11,12] Medical management with steroids and a mydriatic agent for analgesia is routinely recommended, although the evidence for this is not strong.[12] Retrospective studies suggest that 5% of patients with hyphema, on average, require surgery. Indications for surgical management are secondary hemorrhage or pre-existing blood dyscrasia.[2] Typically, patients return to their former visual acuity and function, but are at higher risk for several complications, namely glaucoma and early cataract formation.[13] In one study, at least 7% of those with anterior angle recession on examination developed chronic glaucoma after 1 year or more.[13] Thus, in cases of hyphema and other severe ocular sports injuries, yearly follow-up is imperative. The costs of these sequelae to the individual and the health care system are potentially preventable. Our data strongly support conservative management and prevention of complications to reduce long-term ocular morbidity.

Improving awareness of risk

Our data and evidence from other case reports clearly demonstrate that badminton can be a dangerous sport,[14] yet there appears to be resistance to the use of protective eyewear. Only 40% of our survey respondents expressed willingness to use such equipment. Historically, participants in various sports have shown similar resistance.[15] However, once mandated in sports such as hockey and squash, eye protection has resulted in a significant reduction in injuries.[15] It is our belief that public health and sporting organ-

izations can work to reduce the number of sport-related eye injuries and ultimately prevent the long-term sequelae of eye trauma.

Study limitations

Our retrospective chart review identified a relatively small number of subjects with ocular trauma. As well, the cases analyzed were from a subset of patients referred to the Eye Care Centre at VGH, a tertiary care facility, and thus do not represent all the traumatic eye injury cases that occurred in Vancouver during the study period and were managed by emergency physicians at community hospitals or by primary care physicians. Our study also failed to capture those patients with life- and vision-threatening injuries who required immediate surgical intervention and hospital admission for monitoring and resuscitation. As stated previously, Vancouver has a uniquely diverse population that may limit the generalizability of our findings. Moreover, the small number of eye injuries per sport limited our ability to obtain useful sport-specific survey data.

Summary

Trauma to the eye can range from adnexal abrasions and lacerations to blunt and penetrating orbital injury. Action regarding eye protection in sport needs to be taken on the international, national, and regional levels.

In cases of ocular trauma, it is imperative for primary care physicians to do an initial survey, obtain a thorough history, and complete a physical examination of the eye. Primary care physicians should be confident in managing minor ocular trauma but be aware of potential complications and not hesitate to contact an ophthalmologist should they have concerns.

The patients identified in our chart review experienced a remarkably high rate of badminton-induced traumatic eye injury, a finding that may be due to the unique demographics of Vancouver.[3] As several of these patients experienced severe complications, we recommend that protective eyewear be worn by those participating in the sport. Strict rules and regulations for the use of protective eyewear in badminton would be in keeping with other racquet sports, such as squash. However, our results suggest that education will be needed since only a minority of injured badminton players expressed any willingness to use protective eyewear.

Mandating eye protection for youth, normalizing the use of protective eyewear, and educating those participating in high-risk sports should be considered to reduce ocular trauma. BCMJ

Competing interests

None declared.

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