

Doubles trouble-85 cases of ocular trauma in badminton: clinical features and prevention

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ABSTRACT

Objectives To describe ocular injuries caused by badminton and to explore the implications for future prevention strategies.

Methods We enrolled 85 patients with ocular trauma caused by badminton. Information collected from patients included type of game, instigator, instrument of injury and lessons in badminton from a professional, and ocular trauma information such as type of injury, treatment and final outcomes.

Results The 85 patients (52 men, 33 women) were aged 15–65 years with an average age of 42.9 (± 10.7) years. In 60 cases the player was hit by a shuttlecock and in 25 the player was hit by a racquet. 73 cases occurred in doubles matches and 10 in singles matches. In 31 cases the trauma was caused by an opponent and in 52 cases by a partner; 2 cases involved bystanders, not players. About 70% (43/61) of the injured and 82% (40/49) of the instigators had not received badminton lessons from a professional. 80 injuries were non-penetrating and 5 were penetrating. There were 58 cases with hyphaema, 36 with secondary glaucoma, 23 with lens subluxation and 2 with retinal detachment. Surgery comprised phacoemulsification or lensectomy and vitrectomy in 16 cases, silicone oil tamponade in 2 cases, trabeculectomy in 3 cases and direct cyclohexy in 5 cases.

Conclusion The vast majority of the badminton related eye injuries occurred among doubles players and were instigated by the injured person's partner. Non-penetrating injury was more frequent; penetrating injury was usually more serious. We recommend that badminton players use protective eyewear and receive safety education and professional coaching/instruction on techniques to protect against serious eye injuries.

INTRODUCTION

Although rare, sports related ocular traumas may result in devastating and disabling consequences. The incidence of sports related ocular injuries is regionally dependent, based on the popularity of the sport,¹ specifically badminton. For example,¹ badminton is popular in Southeast Asia and is therefore the leading cause of sports related ocular injuries. In Malaysia, where badminton has been a popular sport for many years, the sport accounts for two thirds of all ocular sports injuries.² The growing popularity of badminton in the Philippines has led to an increased incidence of physical and ocular injuries¹ and, although uncommon, ocular injuries can lead to significant morbidity.^{2–4} Fifty per cent of patients with ocular injuries suffered a permanent decrease in vision, and 11% had a final visual acuity

What are the new findings?

- ▶ Penetrating ocular injuries can occur in badminton. They can lead to permanent vision loss.
- ▶ Doubles players in the forecourt were at the highest risk of ocular trauma because of the risk of being hit by either their partner or their opponent. The most frequent occurrence was the player turning around and being hit by their partner.
- ▶ Ocular complications differ between those seen at initial emergency visits and later outpatient visits. We provided several explanations.
- ▶ Both the injured player and the instigator (often partner) had usually not received any lessons from a badminton professional and were not using eye protection while playing.

How might it impact on clinical practice in the near future?

- ▶ Hyphaema is the most common injury and is prone to progressing to secondary glaucoma. Long term follow-up and close observation are of great importance.
- ▶ Lens subluxation is the leading cause of surgical intervention.
- ▶ We advise special precaution among people with a high risk of vision loss to injury (eg, legally monocular people or those who have had previous ocular surgery).

of 6/60 or worse, with macular changes, traumatic cataract or glaucoma being the main causes of visual impairment.²

Badminton has been gaining popularity in China because it is considered relatively safe due to its lack of physical contact. When considering the risk of ocular trauma, Rodriguez *et al*⁵ categorised sports as low, high or very high risk. Those that include the use of balls and racquets are considered high risk, and badminton has been classified as a high risk sport for ocular injury due to the small, dense shuttlecock that travels at such high speed in close proximity to players.⁶

We hypothesised that badminton related ocular injuries have distinct features, which are important for effective education on how to prevent these injuries. Therefore, the main purpose of this study was to summarise the clinical characteristics



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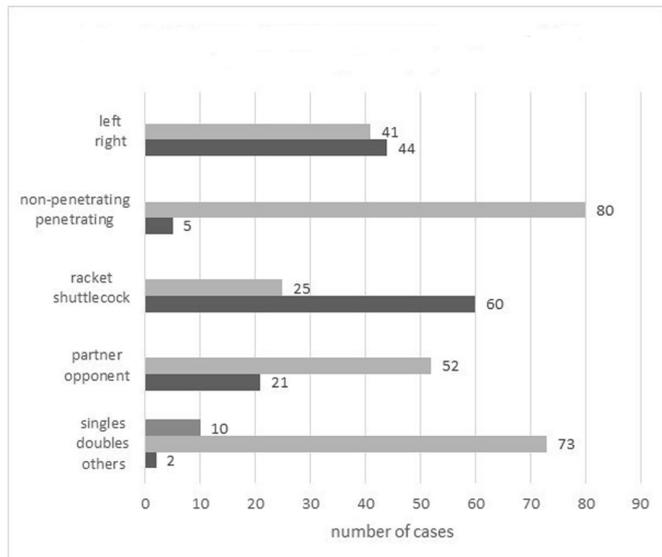


Figure 1 Number of cases stratified by type of game, instrument of injury and type of injury.

and sports related features of 85 patients with ocular injuries acquired when playing badminton.

METHODS

Study design and recruitment

This was a retrospective case series study. From November 2011 to September 2017, the medical histories of all patients with badminton related ocular trauma admitted to the Department of Ophthalmology, Beijing Tongren Hospital, Capital Medical University, Beijing, China, were included and reviewed in the study. There were a total of 85 cases.

Patient involvement

We included 85 consecutive patients with ocular injuries caused by badminton who presented to our outpatient and inpatient departments. Patients were not involved in the conduct of the study. A summary of results will be disseminated to the study participants.

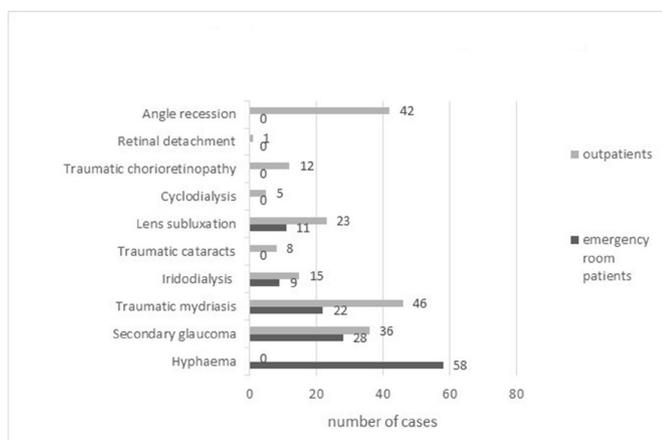


Figure 2 Non-penetrating injuries in emergency room patients and outpatients.

Data collection

The following sports related data were collected using a questionnaire: type of game (singles or doubles), instigator of the injury (partner or opponent), instrument of injury (shuttlecock or racquet), years of playing badminton, badminton lessons from a professional (yes or no) and awareness of the high risk nature of badminton (yes or no). Ophthalmological data were retrospectively extracted from the medical records, including correction of refractive error, previous ocular surgery, type of injury, treatment and final outcome. The study was conducted in accordance with the guidelines of the Declaration of Helsinki, and the study protocol was approved by the institutional review board at Beijing Tongren Hospital, Capital Medical University.

RESULTS

In total, we enrolled 85 patients with ocular injuries, 26 (30.6%) of whom were admitted to hospital for surgical treatment during the study period. Patients ranged in age from 15 to 65 years (42.9 ± 10.7 years). Of the 85 patients, 59 (69.4%) were outpatients and 52 (61.2%) were men. Forty-four (51.8%) patients had an injury to the right eye and 41 (48.2%) to the left eye.

The average years of badminton experience for those injured was 7.9 and for instigators was 5.1. Fifty per cent of those injured were unaware of the high risk nature of badminton. Seventy per cent (43 of 61) of those injured and 82% (40 of 49) of the instigators had not received any professional training or safety education.

In our case series, 73 of 85 patients were injured in doubles games. Among the 52 players who were hit by their partner, 51 were in the front court, and most turned to their partner as they were hitting a shot. None of our patients hit themselves. In most cases, closed globe injuries were less severe than open globe injuries. There were only five patients with open globe injuries in our study but all suffered irreversible vision impairment, and the worst case resulted in blindness. Four of these five cases were hit by a racquet and three of those four injuries resulted from shattered eyeglasses. Final visual acuity in these five cases were 0.15 (20/133 Snellen acuity), no light perception, counting fingers, 0.05 (20/400 Snellen acuity) and 0.01 (20/2000 Snellen acuity). Regarding refractive error correction, 11 patients were wearing eyeglasses, 8 were wearing contact lenses and 3 had undergone refractive surgery. None of the patients wore protective eyewear when they played badminton. The number of cases stratified by type of game, instrument of injury and type of injury are shown in [figure 1](#), details of ocular injuries in [figure 2](#) and vision outcomes in [figure 3](#).

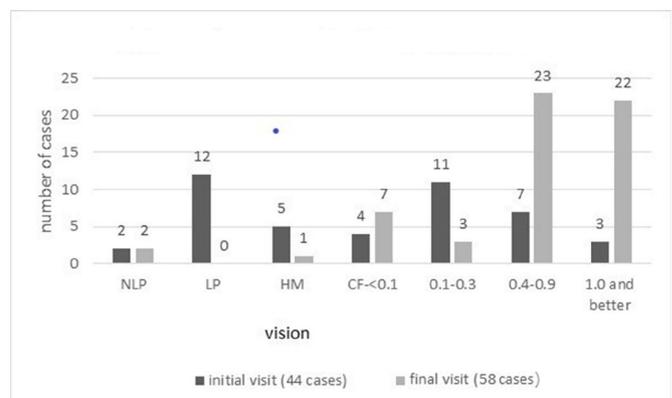


Figure 3 Vision outcomes at the initial and final visits. CF, counting fingers; HM, ; LP, ; NLP, no light perception.

DISCUSSION

Type of game and mechanism of injury

We found that players in doubles games were at higher risk of ocular injury than those in singles games, and more players were hit by their partners than by opponents, by shuttlecocks or racquets. Our findings are consistent with those of previous studies, showing that the more popular doubles game is more ocular accident prone in badminton.^{1-3 7}

Sports Medicine Australia classifies badminton as a high risk sport for ocular injuries due to the small, dense shuttlecock that travels at such high speed in close proximity to players.⁸ According to Rodriguez's sport classification, considering potential eye risk, badminton is among the high risk sports due to the use of a shuttlecock and racquet.⁵ Goldstein⁹ reported that ocular injuries can occur with all sports and affect all ages, including both professional athletes and amateur athletes.⁹ These injuries appeared to be more common among inexperienced or amateur players, especially during doubles games.^{2-4 6 10}

The impact of the shuttlecock depends on the distance from the player hitting the shot.⁴ Because of their aerodynamics, badminton shuttlecocks move quickly,¹¹ and severe blunt eye injuries occur when the distance between players is small; this is particularly relevant when players turn around to look at their double's partner. Rekha Khandelwal *et al*⁴ point out the different mechanisms of injury associated with badminton. In our case series, the leading cause was a shuttlecock hit by a partner in a doubles game, followed by injury from a partner's racquet in doubles, with the third being a shuttlecock from an opponent in a singles game. Shuttlecocks caused more accidents than racquets but injuries from racquets were usually far more severe, producing enough force to knock someone down, break their eyeglasses or even rupture the eyeball.

Type of injury and clinical features

Regarding types of ocular injuries, closed globe injuries are less severe than open globe injuries. Hyphaema is the most common complication and increases the risk of secondary glaucoma. Our findings were consistent with previous reports.^{2 3 12} Despite a short period of elevated intraocular pressure (IOP), the eye can absorb most blood, restoring normal IOP in a stable manner. Management is aimed at reducing initial bleeding and preventing secondary haemorrhage and other complications, including secondary glaucoma and corneal blood staining.^{10 13}

Traumatic chorioretinopathy is relatively rare but can result in irreversible vision loss because of the involvement of the macular area. Poor vision outcomes are usually associated with the involvement of the macular area.^{3 4} Retinal damage, such as retinal commotio and retinal detachment, have been confirmed as important contributors to poorer vision outcomes¹⁴ although they are difficult to identify at the initial emergency visit.

Open globe injuries are less common but usually more serious than closed globe injuries because they require surgical intervention and result in poorer vision outcomes. The final vision in our two cases of eyeball rupture were (i) no light perception (a normal eye hit by a racquet) and (ii) 0.05 (20/400 Snellen acuity, an eye with previous penetrating keratoplasty hit by a shuttlecock). There were only five patients with open globe injuries in our study but all suffered irreversible vision impairment, including the no light perception case. Four of those five were hit by racquets, and three of those four had shattered eyeglasses. Chandran pointed out that eyeglasses may increase the risk of racquet injury,² raising the risk of shattered glass as an intraocular foreign body.³

We also compared the relative frequency of reporting of closed injuries between emergency room and outpatient visits. Secondary glaucoma, traumatic mydriasis, iridodialysis, lens subluxation, cyclodialysis and traumatic chorioretinopathy were more frequently diagnosed in the outpatient setting than in the emergency room; the exception was hyphaema. We have several explanations for this. First, in the emergency room, it is difficult for doctors to discern the details of eye structures in patients with hyphaema, such as traumatic mydriasis, iridodialysis, lens subluxation and traumatic chorioretinopathy. After a period of time, the haemorrhage is absorbed, the refractive media is clearer and the abnormalities are seen, usually during an outpatient visit. Second, conditions change with time. For example, a clear crystalline lens in the emergency room visit could develop traumatic cataract over time, with an opaque cataract detected at a later outpatient visit. Also, a persistent vitreous traction at the time of the trauma could later lead to retinal detachment. Finally, lesions could be concealed due to opposing changes that occurred simultaneously. For example, initially coexistent hyphaema (which may increase IOP) and cyclodialysis (which may decrease IOP) would yield normal IOP. After absorbance of hyphaema, the injured eye would manifest decreased IOP and a shallowed anterior chamber, which are clinical features of cyclodialysis. Therefore, we advise doctors in emergency rooms and outpatient departments to record all details of the injured eye and follow all such patients closely.

Implications for prevention and prevention research

In our study, all patients were amateur players. More than 90% of ocular injuries from sports are preventable.^{5 9} It is critical to provide athletic safety training to badminton players, especially non-professionals. Instigators (those causing injuries) were less experienced than the injured and caused more harm. Therefore, badminton lessons may be useful as part of an injury prevention programme.

Protective eyewear seems important for badminton players. Over the past 40 years, it has been repeatedly reported that none of those injured were wearing protective eyewear while playing badminton, and we report the same experience.^{1-3 6 10 15} Compared with previous studies, Pardhan *et al* found that awareness of the general public concerning the use of protective eyewear has not changed.¹⁶

McLean's survey of racquetball players concerning protective eyewear use revealed several reasons for non-use.¹⁷ Each individual player must weigh the risks and consequences against the possible inconvenience of using some form of eye protection.¹⁸ The majority of those injured in our study were unaware of the risk of ocular trauma in badminton, and none of the players wore any protective eyewear. The Ontario Badminton Association mandated protective eyewear for all junior players and recommended eye protection for all badminton players in 2005.¹⁹ Because of the prevalence of injuries in this study, we suggest protective eyewear would be a practical precaution when playing badminton under any circumstances. For forecourt players in doubles, this becomes even more important.

In addition, it is worth recommending restriction of participation in badminton for certain populations who are at higher risk of ocular injuries (either no participation or with extra precautions).^{5 20 21} We recommend no participation for those who were legally or functionally one eyed or monocular, and extra precautions for those who: (1) are postoperative patients; (2) have undergone post-refractive surgery, such as radial keratotomy or laser in situ keratomileusis (LASIK); (3) have

weakened eyewalls (corneal or scleral staphyloma or degeneration); or (4) have a history of eye disease or trauma, such as high myopia or retinal detachment. Liang *et al*²² and Luong¹⁰ reported two men (85 and 77 years old) with intraocular lenses following cataract surgery, who were hit by a shuttlecock and developed severe complications. In our study, we report that a patient with previous keratoplasty developed eye rupture.

These cases underline the fact that eyes that have undergone intraocular surgery are prone to severe complications. For example, a patient who has had radial keratotomy should be aware that the surgery has weakened the eye and trauma could result in rupture and a poor prognosis. For LASIK, blunt traumatic injury might lead to flap dislocation and even flap loss several months or years after surgery. Therefore, we suggest that LASIK patients wear protective eyewear when participating in contact sports.^{23 24} In our study, there were three patients who had previous LASIK who were hit by a shuttlecock but fortunately they did not experience any LASIK related complications.

We wish to emphasise that secondary glaucoma, traumatic mydriasis, iridodialysis and lens subluxation are diagnosed more frequently in outpatients than in emergency room patients, sometimes well after the initial injury. Therefore, ophthalmologists in emergency rooms and outpatient departments should carefully record all details of the injured eyes and follow all such patients closely. In addition, extra precautions should be taken by people with certain risk factors, such as those with a history of intraocular surgery, high myopia or those who are functionally one eyed, when playing badminton.

In summary, our study has shown that most badminton related eye injuries occurred in doubles players who were hit by their partners. Hence use of protective eyewear is highly recommended, based on expert professional guidance, safety education and awareness of the ocular injuries that can occur.

We recommend professional training by experts, and education on the potential for ocular injuries and how to prevent them, including the use of protective eyewear. Extra precautions, including the option of not playing the game, should be taken if risk factors for injury are high.

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Patient consent for publication Obtained.

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Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Data will be shared upon request under the *BJSM* policy.

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