Original Article

A 3-year prospective study on ocular injuries with tennis or cricket ball while playing cricket: A case series

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Purpose: The purpose of this study is to study the clinical features, visual outcome, management, and ocular complications of ocular injury, following trauma with tennis or cricket ball. **Methods:** A prospective, noncomparative case study of patients having injury with tennis/cricket ball while playing cricket was conducted between January 2013 and April 2016. Seventy-six eyes of 76 patients were studied. Presenting vision, age, gender, time since injury, general and ocular examination, intraocular pressure, indirect ophthalmoscopy, B scan, and X-ray/computed tomography scan findings were noted. Patients were managed medically or surgically as per the need and followed up at least for 6 months. **Results:** Seventy-six eyes of 76 patients were studied. All cases were male, except two. Majority (80.2%) were <25 years. Median presenting visual acuity (VA) was 6/36 and median final VA was 6/18. Significant findings in the decreasing order of frequency were sphincter tear (26.3%), retinal detachment (23.6%), angle recession (18.4%), choroidal rupture (17.1%), and Berlin's edema (15.7%). Most of the cases (69.7%) were managed medically. Only 30.2% cases needed surgical intervention. Final visual outcome in our study was depended on initial VA ($P = 0.000$). It was also correlating with presenting clinical feature ($P = 0.010$) and type of intervention (medical/surgical) ($P = 0.001$). **Conclusion:** Cricket-related ocular injury generally has a poor prognosis with most cases being closed globe injury; retinal detachment is the most common vision-threatening presentation. In spite of being a common event, cricket-related injury is sparingly documented and hence needs further studies for proper documentation, prognostication, and formulation of definitive management plan.

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Cricket is a very popular game in the Indian subcontinent. Youngsters often play cricket with rubber ball, tennis ball, instead of actual hard cricket ball.[1]Although cricket is not a common cause for ocular injury, it can be grievous enough to cause blindness. The personal impact of ocular injury is difficult to define although the lifestyle of the affected individual may be permanently altered.[2,3]

However, to an object as large as a cricket ball, the brow offers substantial protection to the eye when the line of approach is horizontal. This is not so far a rising trajectory especially when the ball approaches obliquely from the side; indeed, rupture of the globe is most frequent from a blow directed from the lower and lateral side.[4]

Worldwide, every year, there are approximately 1.6 million people blinded from ocular injuries and approximately 2.3 million people with bilateral low vision results from eye injuries.[5] Retinal detachment has been reported to occur in up to 9% of contusions but may take many years to develop.[6] In addition, the rates at which eye injuries require hospitalization are in the range of 4.989/10 million in developing countries.[7-12]

Delayed diagnosis, poor initial visual acuity (VA), hyphema, lens disruption, extent of wound, vitreous prolapse, posterior location of the wound, polymicrobial infections, infections by virulent organisms, presence of intraocular foreign bodies, and rural setting adversely affect visual prognosis.[13-18]

Even after extensive search on this subject, there are few available data showing vision-threatening complications, need for surgical intervention, and final visual outcome after treatment related to tennis/cricket ball ocular injury.

Hence, the aim of this study was to find out demographic profile, describe various clinical presentations, find out the need for medical or surgical intervention and their type, vision-threatening complications as well as final visual outcome at 6-month follow-up following tennis/cricket ball injury to the eyes attending our hospital between January 2013 and April 2016.

Methods

The institutional ethical committee's approval was obtained, and informed consent was taken from all study participants in accordance with the guidelines of the Declaration of Helsinki.

The study included all the cases presenting to a tertiary care eye hospital in Eastern India with cricket ball trauma to the eye from January 2013 to April 2016, which included 76 eyes of 76 cases between 7 and 38 years of age, except one

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bystander who was 75 years old. All of them were male except two (females) who attended our hospital with the complaints of decreased vision, following trauma with cricket ball with or without other complaints such as redness and pain. Each eye was taken as a single case.

Data regarding the case were collected on a standardized form, which included age, sex, address, presenting vision, time of presentation, duration of decreased vision, type of intervention (medical or surgical), number of follow-ups, sequelae, complications, and final visual outcome. VA was recorded by Snellen's chart. A detailed history was taken. Examination of the anterior segment was performed by slit lamp, and intraocular pressure was recorded by applanation tonometer. Posterior segment was examined in slit lamp with + 90D lens and with indirect ophthalmoscope with indentation wherever applicable. Indentation was done when the globe was formed with a clear media with minimal ocular inflammation. A detailed corneal and retinal drawing was charted on standard charts with conventional color code. Slit lamp photograph, fundus photograph, optical coherence tomography (OCT), B scan, and X-ray/computed tomography scan were done as per the need. Datasheet also contained type of first surgical intervention and subsequent surgical intervention if needed and materials used. Gonioscopy was done in all eyes without hyphema and exudates in anterior chamber. All cases of Berlin's edema (12) and posterior choroidal rupture (13) with clear media underwent OCT. Medically managed patients were followed up at weekly interval for 1 month and then monthly interval for 6 months. Surgically managed patients were seen on the postoperative day 1, day 7, day 15, and day 30 and monthly interval afterward for 6 months. The presenting vision is categorized into poor vision (VA <6/60), moderate vision (VA ≥6/60– ≤6/18), and good vision (VA >6/18).

All data were analyzed using SPSS software version 19.0 (IBM SPSS Statistics 24, www.spss.co.in, India) for Windows. Statistical analysis was done and significance of correlation for each parameter was calculated using Chi-square test and descriptive statistics. Percentages and frequencies were calculated for demographic variables as well as clinical parameters. The mean was computed for age. Tables and graphs were used to present the results.

Results

The study included 76 eyes of 76 cases between 7 and 38 years of age except one bystander who was 75 years old. All cases were male except two. The mean ± standard deviation of age was 22.1 ± 8.8 years and the median age was of 21 years.

Cases presented with a variety of clinical findings along with diminution of vision. We found that subconjunctival hemorrhage was the most frequent finding (81.5%), followed by sphincter tear (26.3%). Vision-threatening findings in the decreasing order of frequency were retinal detachment (23.6%), followed by angle recession (18.4%), choroidal rupture (17.1%) [Fig. 1a], vitreous hemorrhage (15.8%), lens-related injury (15.8%), and Berlin's edema (15.8%). Six cases of lens subluxation/dislocation seen in our study were included in the lens-related injury category as mentioned in Table 1. The mean IOP at presentation was 16.59 mmHg and in final follow-up was 11.13 mmHg. Twelve

Table 1: Important presenting features of cricket ball injury (*n*=76)

	n (%)
Features	
ST	20 (26.3)
CR	13 (17.1)
RD	19 (25)
VH	13 (17.1)
AR	15 (19.7)
Hyphema	12 (15.8)
Berlin's edema	12 (15.8)
Lens-related injury	12 (15.8)
RT	7 (9.2)
Cases with multiple features	
No feature	14 (18.4)
Single feature	24 (31.6)
2-3 features	33 (43.4)
>4 features	5 (6.6)

CR: Choroidal rupture, RD: Retinal detachment, VH: Vitreous hemorrhage, RT: Retinal tear, AR: Angle recession, ST: Sphincter tear

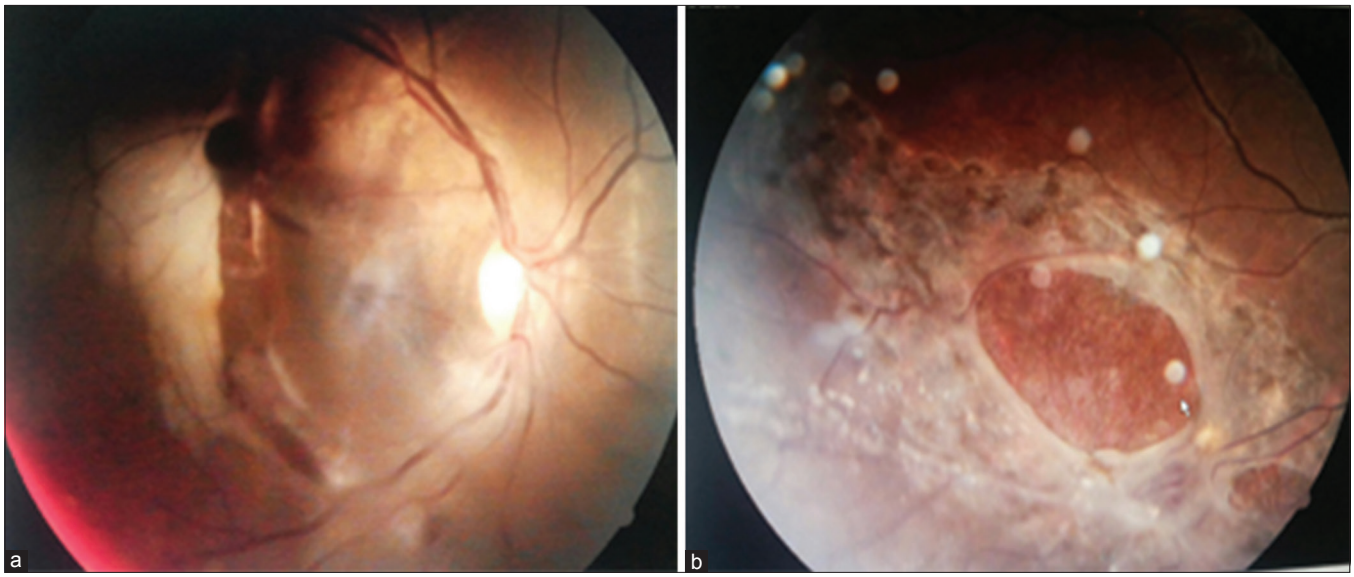

Figure 1: (a) Fundus photograph showing choroidal rupture. (b) Fundus photograph showing silicon oil filled eye following retinal surgery

cases in our study had glaucoma which included 10 patients of angle recession and 2 patients of hyphema [Table 1].

In our study, we had 32 patients (44.7%) with poor presenting vision, 8 patients (9.2%) with moderate vision, and 25 patients (32.8%) with good vision at presentation. Out of these 32 presented with poor vision, 19 (29.2%) remained as such, 9 (28.1%) improved to moderate, and 4 (12.5%) to good vision. Similarly, eight presented with moderate vision, of which three (37.5%) improved to good vision. All 25 cases that presented with good vision were maintained as such. Eleven patients were lost to follow-up, and the data of 65 patients are presented in Table 2. It revealed a significant association of presenting VA with final VA ($P = 0.000$) [Table 2]. Presenting vision has a significant positive correlation with final VA with a correlation coefficient of 0.556 ($P \leq 0.001$). The regression of final VA has significant intercept (constant) of 0.335 ($P < 0.00100$) and significant slope (B) of 1.253 ($P < 0.001$), indicating that good initial vision will have better final VA.

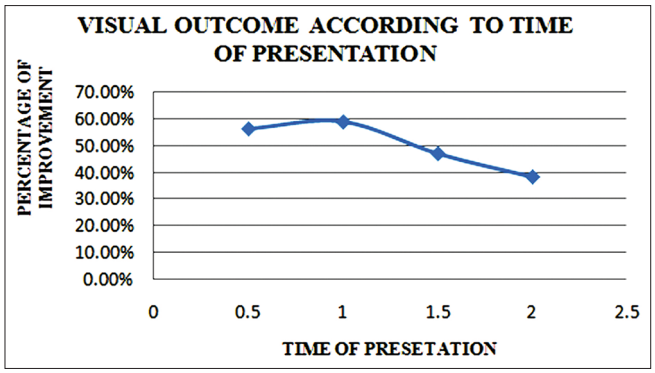

Figure 2: Graph showing visual outcome versus time since injury

Number of lines of improvement has a mean of 2.17 ± 3.024 with a median (interquartile range [IQR]) of 1 (0–4).

Out of 76 cases, 16 presented to us within 48 h, 17 presented between 2 and 7 days period following injury, 17 presented 7 days to 1 month period following injury, while 26 presented after 1 month of cricket ball injury [Fig. 2]. Eleven cases presented after 1 year of injury. The median time of presentation with IQR was 11.5 days (3–105.5 days). We found no significant difference in final visual outcome in the group presented in first 48 h and between 2 days and 1 week period. However, there is a significant difference in final visual outcome in the group presented between 2 days and 1 week period and after 1 month of cricket ball injury. Vision got improved in 56.2% of cases who presented within 48 h while vision got improved in 58.8% of cases who presented between 2 days and 1 week period. Similarly, cases presented within 1st week to 1 month had visual improvement in 47.0% of cases, while cases presented after 1 month had visual improvement in only 38.4% of cases. Hence, time of presentation following trauma can have bearing on final visual outcome, but statistical correlation is not significant ($P = 0.297$).

Our study showed that involvement of posterior segment leads to poor vision at presentation. These conditions include choroidal rupture, vitreous hemorrhage, retinal detachment, Berlin's edema, and retinal tear mainly. In our study, we found that 32 out of total 76 cases had presenting vision of < 6/60, among which 25 had posterior-segment involvement. Injury in the posterior segment had 60.8% poor vision at the presentation, while injury in the anterior segment had 18.8% presenting poor vision ($P = 0.010$). Anterior-segment injury had 73.3% good final VA, while posterior-segment injury had 36.6% good final VA. Thus, anterior-segment injury has better association with good final VA ($P = 0.048$) [Table 3].

Table 2: Association of presenting vision and final visual acuity

Presenting VA	Final VA				χ^2, *P*
	Poor vision, *n* (%)	Moderate vision, *n* (%)	Good vision, *n* (%)	Total, *n* (%)	
Poor vision	19 (59.4)	9 (28.1)	4 (12.5)	32 (100)	χ^2=53.937
Moderate vision	0	5 (62.5)	3 (37.5)	8 (100)	*P*=0.000
Good vision	0	0	25 (100)	25 (100)	
Total	19 (29.2)	14 (21.5)	32 (49.2)	65 (100)	

VA: Visual acuity

Table 3: Association of area of involvement with initial and final visual acuity

	Area of involvement			χ^2, *P*
	Posterior segment, *n* (%)	Anterior segment, *n* (%)	Total, *n* (%)	
Presenting VA				
Poor vision	31 (60.8)	3 (18.8)	34 (50.7)	χ^2=9.306
Moderate vision	7 (13.7)	3 (18.8)	10 (14.9)	*P*=0.010
Good vision	13 (25.5)	10 (62.5)	23 (34.3)	
Total	51 (100)	16 (100)	67 (100)	
Final VA				
Poor vision	16 (39)	2 (13.3)	18 (32.1)	χ^2=6.076
Moderate vision	10 (24.4)	2 (13.3)	12 (21.4)	*P*=0.048
Good vision	15 (36.6)	11 (73.3)	26 (46.4)	
Total	41 (100)	15 (100)	56 (100)	

VA: Visual acuity

Table 4: Details of surgical intervention

Serial number	Age/ sex	Presenting finding	Procedure	BCVA		
				Preoperative	Postoperative	Final
1	20/male	RD	SB	6/36	6/60	6/36
2*	18/male	RD, retinal dialysis	SB	CF 2 months	CF 3 months	6/12
3	18/male	RD, RT	SB	CF 1/2 months	CF 1.5 months	CF 1.5 months
4	18/male	Hyphema, VH, 2° glaucoma, AR	PPV + EL + AGM	HM+	6/24	6/6
5*	17/male	RD, VH	BB + PPV + FAX + EL + SOI	CF close	CF 3 months	6/18
6*	17/male	RD, GRT	BB + PPV + SOI + CRYO + FAX	HM+	CF 1 months	6/36
7	13/male	RD, SRGB, RT	SB + AGM	CF 1.5 months	CF 2 months	6/36
8	15/male	Cataract, AR RD (B scan)	SB + PPV + PPL + SOI + PHACO + PCIOL	HM+	HM +	CF close
9	23/male	LD+VH	PPV + PPL + FAX	CF close	CF close	CF 4 m
10*	33/male	360° postsynechiae, cataract	BB + PPL + PPV + MP + FAX + EL + SOI + AGM	HM+	HM+	CF close
11	32/male	Cataract	Lens extraction + AV	CF close	6/12	6/12
12	32/male	CR, VH, RT RE	PPV + C3F8 gas + AGM	CF 1/2 months	CF 1/2 months	CF 1 months
13	23/male	Subtotal RD	SB + PPV + SOI + EL	6/36	6/24	6/24
14	21/male	ST, phacodonesis, RD	BB + PPV + EL + FAX + SOI	CF 2 months	6/60	6/60
15*	23/male	Zonular dialysis, cataract, RD	BB + PPV + MP + FAX + EL + SOI → SOR + SICS + FAX	CF close	CF close	CF close
16	18/male	INF RD, SRGB	SB ± (PPV + SOI)	6/9	6/6	6/6
17	23/male	ST + phacodonesis + INF RD	BB + PPV + EL + MP + FAX + SOI	HM+	CF 1 months	CF 1 months
18	23/male	Inferior RD	SB	6/6	6/6	6/6

*Re surgery required, †Cases lost to follow-up are excluded from the table. AGM: Anti glaucoma medications, BCVA: Best corrected visual acuity, CF: Counting finger, CR: Choroidal rupture, RD: Retinal detachment, VH: Vitreous hemorrhage, GRT: Giaretinal tear, RT: Retinal tear, AR: Angle recession, RE: Retinal edema, ST: Sphincter tear, SRGB: Sub retinal gliotic bands, PPV: Pars plana vitrectomy, PPL: Pars plana lensectomy, SB: Scleral buckle, EL: Endolaser, SOI: Silicon oil injection, FAX: Fluid air exchange, MP: Membrane peeling, AV: Anterior vitrectomy, CRYO: Cryotherapy, PHACO: Phacoemulsification, PCIOL: Posterior chamber intraocular lens, LD: Lens dislocation, SICS: Small incision cataract surgery, SOR: Silicon oil removal, INF: Inferior, HM: Hand movement, BB: Belt buckle

Majority of the cases (69.74%) needed medical management only. The conservative management included topical antibiotic, steroids, cycloplegics, antiglaucoma, and anti-inflammatory agents. Systemic medications included oral steroids, analgesics, antibiotics (ciprofloxacin/injection cefotaxime), and oral acetazolamide.

Out of 76, 23 (30.26%) cases required surgical intervention. Surgical intervention included various surgeries such as belt buckle, scleral buckle, pars plana vitrectomy, pars plana lensectomy, endolaser, silicon oil injection [Fig. 1b], C3F8 gas injection, and membrane peeling. Five patients with silicon oil injection underwent silicon oil removal and fluid-air exchange 2–3 months later. Out of 23 cases, only one underwent phacoemulsification with IOL placement while the remaining 22 were advised vitreoretinal surgery. Among surgically treated cases, vision got improved in 15 cases, and in three cases, vision remained the same, and five cases were lost to follow-up [Table 4]. The correlation between initial and final VA in both medically and surgically managed group is presented with a two-way scatter plot [Fig. 3], which shows a strong positive correlation in both the groups. *R* square with surgical intervention appears to have better relationship than the medical intervention.

We did not come across any cases with leather ball injury as all the reported cases are from nonprofessional cricketers playing recreational cricket. Distribution of patients injured with tennis, rubber, and cork ball is as follows: tennis ball (69), rubber ball (5), and cork ball (2). In our study, recreational cricketers who were mostly injured were batsmen (53), followed by wicketkeepers (12), bowlers (5), fielders (3), and spectators (3).

Discussion

Sight is most cared for function in human beings. Although nature has provided a protective bony wall and lids to cover the eye and protect it from injury, still it is exposed to all types of trauma.[18,19] Ocular trauma that occurs because of a ball is mostly a closed globe injury.[20]

Sports-related ocular injury is not uncommon. However, ocular trauma due to cricket ball injury is a less reported event. Eye injury due to tennis ball while playing cricket is found to be very common in the Indian subcontinent, but this commonly occurring event is not reported in the literature. We compared findings of our study with the related articles to find out the similarities and differences with other studies to derive conclusions from our results [Table 5].

The mean age in our study was 22.13 ± 17.5 years which included 74 males and two females. Both the females and one senior citizen were bystanders who got injured accidentally.

Table 5: Comparison with other similar studies

Study	Alliman *et al.*[21]	Horn *et al.*[22]	Park *et al.*[25]	Sadiq *et al.*[23]	Present study
Object	Paintball	Soccer ball	Golf ball	Tape-ball	Rubber ball/tennis ball/hard cork ball
Sample	36	13	13	20	76
Mean age	21 years	8-21 years, median - 14 years		11-78 years median 20.5 years	22.13±17.5 years (95% CI)
Sex	86% male	9 male, 4 female		19 male, 1 female	74 male, 2 female
Initial BCVA	<20/200 in 78%	≤20/200 in 54%		≤20/200 in 60%	<3/60 - 42.11%, 3/60 - 6/60-7.89%, 6/36-6/18 - 14.47% and >6/18 - 35.53%
Common finding	Hyphema in 81%(most common)	Macular hole, RD, RT, CR, VH, Berlin's edema	LS (38.5%), CR (30.8%), commotio retinae (38.5%), TON (7.7%) and 12 (54.5%) orbitai wall fractures	Reduced vision, ocular pain, redness, and floaters and retinal findings	Majority-blurring of vision and superficial injuries such as SCH and lid edema. Also, ST - 26.31%, CR - 17.10%, VH - 15.79%, RD - 23.68%, AR - 18.42%, hyphema - 13.16%, Berlin's edema - 15.79%, lens-related injuries - 15.79% and RT - 9.21%
Type of management	Initially 56% -medical and 25% surgical, then 81% - surgical	6 - observed 7 - surgical	Surgical intervention in all	Standard treatment	Surgical intervention in 30.26%, conservative management in 69.74%
Final visual outcome	≥20/40 in 36%, <20/200 in 50%	≤20/200 in 23%		Severe or total vision loss in half	Improved - 48.68%, remained same - 21.05%, deteriorated - 2.63%, lost follow-up - 27.63%
Follow up	11.7 months (mean)	8 months (median)		Minimum 3 months	Mean 6 months

BCVA: Best-corrected visual acuity, CR: Choroidal rupture, RD: Retinal detachment, VH: Vitreous hemorrhage, RT: Retinal tear, AR: Angle recession, ST: Sphincter tear, LS: Lens subluxation, CI: Confidence interval, SCH: Sub-conjunctival haemorrhage, TON: Traumatic optic neuropathy

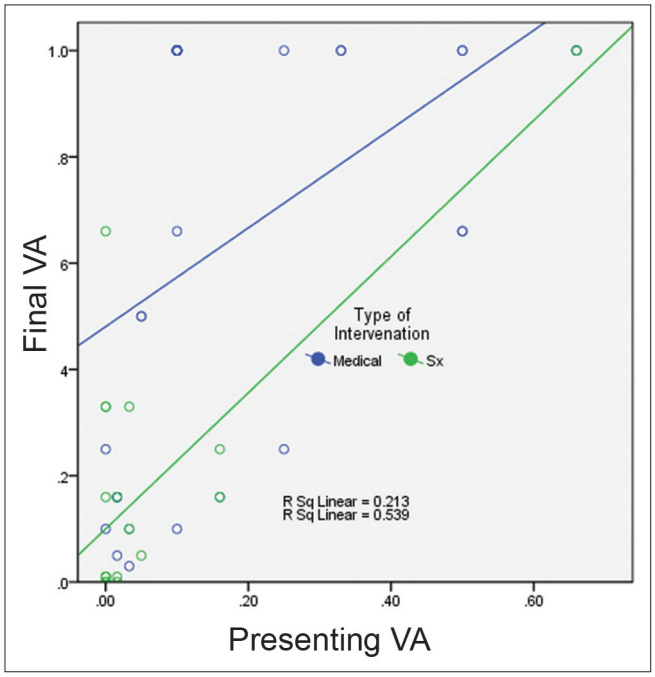

Figure 3: Scatter plot showing correlation between initial and final visual acuity

However, in a study by Alliman *et al.*,[21] for paintball-related ocular trauma, the mean age was 21 years (3–64) with 31 (86%) being males. Similarly, the median age of 14 years with range of 8–21 years was present in a study done by Horn *et al.*[22] on soccer ball-related retinal injuries which included nine males and four females. A tape-ball cricket-related eye injury study by Sadiq *et al.*[23] in 2017 showed median age of 20.5 years (range, 11–78 years) which included 19 males and one female (bystander).

A retrospective study by Alliman *et al.*[19-21] in 2009 showed that hyphema was the most common ocular finding in 29 eyes (81%) attributable to paintball-related ocular trauma. Similarly, Horn *et al.*[19-22] did a study on soccer ball-related retinal injuries, in which four patients had traumatic macular holes, two eyes had retinal detachment associated with retinal dialysis, two had retinal tears associated with hemorrhage, one had a choroidal rupture, and one had only vitreous hemorrhage and Berlin's edema. Sadiq *et al.*[23] in 2017 found that retina was the most commonly involved ocular structure. However, in our study, out of 76 cases, majority of cases had blurring of vision in association with superficial injuries such as subconjunctival hemorrhage, lid edema, uveitis, conjunctival congestion, and chemosis. The most common finding leading to diminution of vision was retinal detachment, followed by choroidal rupture, vitreous hemorrhage, Berlin's edema, and hyphema.

Kuhn *et al.*[24] in the year 2006 analyzed information on 11,320 eyes in the United States Eye Injury Registry database and found that involvement of the posterior segment was a factor indicating poor outcome in ocular injury. In particular, vitreous hemorrhage, retinal detachment, choroidal rupture, and endophthalmitis were found to increase the risk of blindness.[24] Our study showed that involvement of posterior segment leads to poor vision (<6/60) at presentation. These conditions include choroidal rupture, vitreous hemorrhage, retinal detachment,

Berlin's edema, and retinal tear mainly. In our study, we found that 32 out of 76 cases had presenting vision of < 6/60, of which 25 had posterior-segment involvement.

No case of rupture globe or endophthalmitis was seen in our study as most of the injuries were due to coup and counter-coup resulted from a tennis ball which is softer in comparison to other balls such as cork, golf, or tape-ball, resulting in manifestations of ocular injuries due to blunt trauma in contrast to other studies,[15,16,21,25] where penetrating ocular injuries and ruptured globe were reported resulting in endophthalmitis.

In ocular trauma studies related to paintball and soccer ball, surgical intervention was required in most of the cases.[21,22] Sadiq *et al*. showed that surgery was done in almost 60% of cases and there was severe or total vision loss in half of the eyes of cricket tape-ball-related eye injury study.[23] In contrast, only 23 (30.26%) cases required surgical intervention in our study and vision got improved in almost half (48.68%) of the cases presented to us.

The Indian subcontinent is a cricket crazy region where cricket is played in different forms using tennis ball, rubber ball, or hard cork ball. In spite of commonly occurring ocular injuries due to this form of game, no study is found on literature search on tennis ball-related ocular injury while playing cricket. Cricket ball-related ocular injury affects economically most productive age group and even the bystanders.

Although useful vision could be obtained in most of the cricket ball-induced ocular trauma by medical and/or surgical intervention, more emphasis should be given on the preventive aspect such as use of protective helmet. Education and awareness are two additional factors that can effectively reduce the number of ocular injuries and ophthalmologists can and should play a key role in this scenario.

Conclusion

In our study, the most common symptom is blurring of vision, the most common sign is subconjunctival hemorrhage, and the most common findings causing poor final visual outcome were retinal detachment, choroidal rupture, and vitreous hemorrhage in the order of frequency. Posterior-segment involvement leads to poor vision at presentation and poor final visual outcome. No case of globe rupture or endophthalmitis was seen in our study as most of the injury was closed globe injuries by a softer material such as tennis ball. Only one-third of cases needed surgical intervention and nearly half of these cases had visual improvement following surgery. Final visual outcome in our study mainly depended upon presenting vision, time of presentation since injury, presenting clinical finding, and type of intervention. As this common and vision-threatening ocular injury is not reported in literature to the extent it should be, we strongly recommend multicentric study on this innovative area of sports-related ocular injury to prognosticate and formulate definite management plans.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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