

# Ocular findings following trauma from paintball sports

M Taban, M Taban and JE Sears

## Abstract

**Purpose** To raise awareness of potential significant ocular damage and visual loss secondary to paintballs in those not wearing ocular protection and to report high incidence of chorioretinitis sclopetaria from paintball contusion.

**Methods** We reviewed cases of eye injury presenting to a single institution from 2000 to 2005. Those cases in which the injury was attributed to paintballs were identified and evaluated to determine ocular findings and visual prognosis.

**Results** Ocular paintball injuries occurred in eight male subjects and one female subject (nine eyes) with an average age of 16 years (range, 11–26). None had ocular protection at the time of ocular injury. On initial examination, vitreous haemorrhage was present in six eyes (67%), maculopathy, hyphema, cataract, and commotio retinae were each present in four eyes (44%). Two eyes suffered retinal detachment and one eye an optic nerve avulsion. Chorioretinitis sclopetaria occurred in four eyes (44%). The final visual acuity was  $\geq 20/40$  in three eyes,  $20/50$  to  $20/150$  in two eyes, and  $\leq 20/200$  in four eyes.

**Conclusion** Injuries owing to paintballs can result in severe ocular damage and visual loss. Increased awareness and need for proper ocular protection should be emphasized by ophthalmologists. Chorioretinitis sclopetaria occurs with a high frequency and its presence should be recognized, as its management is different from retinal tear or detachment.

*Eye* (2008) 22, 930–934; doi:10.1038/sj.eye.6702773; published online 16 March 2007

**Keywords:** chorioretinitis sclopetaria; ocular trauma; paintball; paintball sports; sclopetaria

## Introduction

A variety of retinal and choroidal problems can result from trauma to the globe, such as subretinal haemorrhage, choroidal haemorrhage, retinal necrosis and atrophy, retinal tear or detachment, retinal dialysis, macular hole, traumatic maculopathy, commotio retinae, choroidal rupture, and chorioretinal rupture. The latter is also referred to as chorioretinitis sclopetaria (sclopetaria), which is traditionally associated with a high velocity missile that penetrates the orbit and passes adjacent to (or grazes), but does not penetrate, the globe.<sup>1</sup>

Originally manufactured and used by farmers and ranchers for marking trees and livestock, paintball has gained tremendous popularity among players of combat simulated games ('war games'), leading to an increasing number of ocular injuries. Reports of eye injuries owing to paintballs began appearing in the medical literature as early as 1985.<sup>2</sup> Since 1985, at least 200 cases have appeared in the English literature.<sup>3–24</sup>

In this report, we describe our experience with ocular paintball injuries and highlight the occurrence of sclopetaria secondary to this type of missile, even though it does not penetrate the orbit.

## Materials and methods

We retrospectively reviewed cases of eye injury presenting to the Cole Eye Institute from 2000 to 2005. Those cases in which the injury was attributed to paintball sports were identified and evaluated to determine ocular findings and visual prognosis. The protocol was approved by the institutional review board at the Cleveland Clinic (IRB 8571).

To obtain previous reports of ocular paintball injuries, a PUBMED search was conducted using the following combination of search

Department of Ophthalmology, Cole Eye Institute, Cleveland Clinic Foundation, Cleveland, OH, USA

Correspondence: JE Sears, Cole Eye Institute, Cleveland Clinic Foundation, Medical and Surgical Retina/i32, 9500 Euclid Avenue, Cleveland, OH 44195, USA  
 Tel: +1 216 444 8157;  
 Fax: +1 216 445 2226.  
 E-mail: searsj@ccf.org

Received: 29 October 2006  
 Accepted: 7 February 2007  
 Published online: 16 March 2007

**Proprietary interest:** None  
**Research Support:** None  
 Presented in part at the 24th Annual Meeting of the American Society of Retina Specialists & 6th Annual Meeting of the European Vitreo-Retinal Society, September 9–13, 2006, Cannes, France

**Table 1** Details and ophthalmic findings of patients with paintball injuries in our series

Case	Age/sex	Referring diagnosis	RAPD	Visual acuity		Follow-up	Ophthalmic findings	Intervention
				Initial	Final			
1	16/F	Complex RRD	No	CF 1'	20/400	6 weeks	Sclopetaria, VH, CR, traumatic maculopathy, iridodialysis, hyphema, conjunctival laceration, corneal abrasion, corneal oedema	Globe exploration, PPV
2	11/M	Ocular trauma	No	CF 1'	20/200	6 weeks	Sclopetaria, CR, traumatic maculopathy, traumatic cataract	Lensectomy
3	24/M	Ocular trauma	Yes	HM	20/70	1 month	Sclopetaria, VH, traumatic optic neuropathy, traumatic maculopathy, conjunctival laceration, hyphema, corneal oedema, medial wall fracture	Globe exploration
4	15/M	Traumatic cataracts, corneal oedema	No	HM	20/25	7 months	Traumatic cataract & subluxation, glaucoma (2° angle closure), corneal oedema	Trabeculectomy, PPV, Ahmed implant, lensectomy with sutured PCIOL
5	13/M	Ocular trauma	No	?	20/200	5 months	CR, traumatic maculopathy, cataract, angle deformation	Observation
6	15/M	VH	No	20/100	20/25	7 months	Giant retinal tear with RRD (macula on), CR, VH	Globe exploration, PPV, EL, retinectomy, SB, C <sub>3</sub> F <sub>8</sub>
7	12/M	Ocular trauma	Yes	LP	20/100	5 months	Ruptured globe, RRD, VH, corneal oedema, subluxated lens, cyclodialysis cleft, ERM, traumatic optic neuropathy	Globe repair, PPV, EL, SB, C <sub>3</sub> F <sub>8</sub> , lensectomy
8	26/M	Ocular trauma	Yes	NLP	NLP	1 month	Sclopetaria, optic nerve avulsion, subretinal haemorrhage, VH, hyphema, corneal abrasion, corneal oedema	Enucleation
9	15/M	Ocular trauma	No	HM	20/40	13 months	VH, hyphema, traumatic cataract, subluxated lens, corneal oedema, corneal abrasion, superficial corneal and conjunctival laceration, iridodialysis, secondary glaucoma, (corneal scar)	PPV, EL, lensectomy with sutured PCIOL, Ahmed implant

CF, count fingers; CR, commotio retinae; EL, endolaser; ERM, epiretinal membrane; F, female; HM, hand motions; LP, light perception; M, male; PCIOL, posterior chamber intraocular lens; PPV, pars plana vitrectomy; RAPD, relative afferent pupillary defect; RRD, rhegmatogenous retinal detachment; SB, scleral buckle; VH, vitreous haemorrhage.

terms: *paintball, paintball sports, and sports injuries*. Additional studies were identified from bibliographies of the retrieved articles.

**Results**

Ocular paintball injuries occurred in eight male subjects and one female subject (nine eyes) with an average age of 16 years (range, 11–26). None had ocular protection at the time of ocular injury. On initial examination, vitreous haemorrhage was present in six eyes (67%), maculopathy, hyphema, cataract, and commotio retinae were each present in four eyes (44%) (Tables 1 and 2). Two eyes suffered retinal detachment and one eye an optic nerve avulsion. Sclopetaria occurred in four eyes (44%) (Figure 1).

Initial surgical management consisted of pars plana vitrectomy in five eyes (56%), lens removal in four eyes (44%), scleral buckle in two eyes (22%), repair of an open globe injury in one eye (11%), and enucleation in one eye (11%). One patient had no surgery (11%). Among the cases with sclopetaria, one patient underwent vitreoretinal surgery (case 1). In this case, a dense

vitreous haemorrhage prevented adequate view of posterior segment and ultrasound revealed an area suspicious for a possible retinal tear and detachment, pars plana vitrectomy was performed, which revealed sclopetaria.

Follow-up time averaged 5 months (range, 1–13 months). On the final examination, the visual acuity was  $\geq 20/40$  in three eyes, 20/50–20/150 in two eyes, and  $\leq 20/200$  in four eyes. Seven eyes (78%) had improvement in visual acuity compared with the initial examination, one eye (11%) had the same visual acuity, and for one eye (11%) the initial visual acuity was unknown. The reason for diminished visual acuity in patients with visual acuity of  $\leq 20/50$  was traumatic maculopathy in four eyes (44%), optic neuropathy in two eyes (22%), optic nerve avulsion in one eye (11%), and epiretinal membrane in one eye (11%).

Details of ocular injury could be obtained from 171 previous eyes reported in the literature (Table 2). Similar to our series, hyphema and vitreous haemorrhage represented the most prevalent major findings, 80 and 35%, respectively. Choroidal rupture was reported in 21 eyes (12%).

**Discussion**

Paintballs are small gelatin-shelled projectiles that are 17 mm in diameter, filled with non-toxic, water-soluble paint, and intended to explode on contact with an object with speeds up to 300 ft/s (91.5 m/s, 200 miles/h).<sup>3,4</sup> With 9.64 million paintball participants in the United States alone, paintball is the third most popular ‘extreme’ sport, behind inline skating and skateboarding.<sup>25</sup> From 1997 to 2001, an estimated 11 998 people aged 7 years and older with paintball game related injuries were treated in hospital emergency departments for an average annual rate of 4.5 per 10 000 participants. Overall, the most common body part affected was the eye (42.7%).<sup>26</sup>

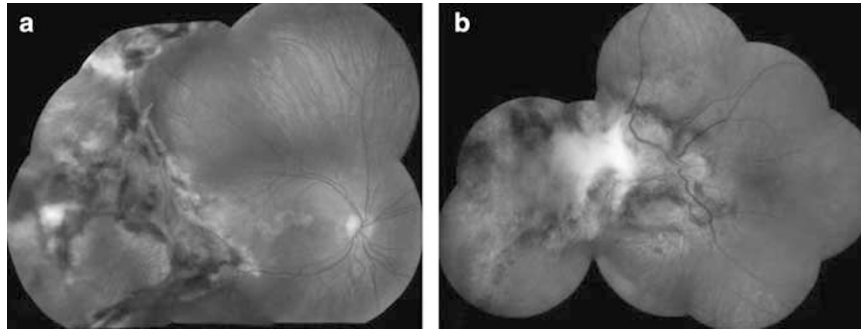
The best available data suggest that ocular injuries caused by paintballs leave at least 30% of individuals with  $\leq 20/200$  best-corrected visual acuity.<sup>3</sup> When ocular injuries were specified in the literature, vitreous haemorrhage and hyphema have been the most common findings as in our series (Table 2). However, we also noted a high frequency (44%) of sclopetaria in our series. Reports in the literature suggest that choroidal rupture occurs in 12% of patients, and retinal tear in 27% (Table 2). It may well be that the term sclopetaria was not appreciated in these cases because of confusion inherent in the term and/or considering the setting of this finding as it is usually reserved for cases of high speed projectiles penetrating orbit, but not globe.

Goldzieher, in 1901, introduced the term chorioretinitis plastica sclopetaria to describe the appearance of direct

**Table 2** Type and frequency of ocular findings secondary to ocular paintball injuries

Injury	No. (%)	
	Previous reports (171 eyes)	Cole eye institute (nine eyes)
<i>Globe</i>		
Ruptured globe	10 (5.8)	1 (11)
<i>Anterior segment</i>		
Hyphema	137 (80)	4 (44)
Cataract	51 (30)	4 (44)
Corneal abrasion/oedema/ laceration	36 (21) <sup>a</sup>	6 (67)
Subluxated lens	12 (7.0)	3 (33)
Iridodialysis/angle recession	38 (22) <sup>a</sup>	3 (33)
Glaucoma	12 (7.0) <sup>a</sup>	2 (22)
Conjunctival laceration	3 (1.8) <sup>a</sup>	3 (33)
<i>Posterior segment</i>		
Vitreous haemorrhage	60 (35)	6 (67)
Commotio retinae	32 (19)	4 (44)
Retinal tear/detachment	46 (27)	2 (22)
Choroidal rupture	21 (12)	4 (44)
Macular hole	4 (2.3)	0
Maculopathy	4 (2.3) <sup>a</sup>	4 (44)
Optic neuropathy	3 (1.8) <sup>a</sup>	2 (22)
Epiretinal membrane	3 (1.8)	1 (11)
Chorioretinitis sclopetaria	0	4 (44)
Optic nerve avulsion	0	1 (11)

<sup>a</sup>Low estimate as some series did not report some complications.



**Figure 1** Fundus photos. (a) Case 1; (b) Case 3. Both cases reveal the entity of chorioretinitis sclopetaria, as well traumatic maculopathy.

**Table 3** Injuries associated with chorioretinitis sclopetaria

Airbag	Metal nozzle
Airgun pellet	Metal rod
BB pellet	Miscellaneous missile
Fishing line sinker	Shotgun
Gunshot bullet	

choroidal and retinal rupture in the peripheral retina following trauma from a bullet wound in the orbital area.<sup>27</sup> The abbreviated term, chorioretinitis sclopetaria, is now more commonly used, however, the terms chorioretinitis proliferans, traumatic proliferating chorioretinitis, retinitis sclopetaria, retinitis sclopetarium, and acute retinal necrosis have all been used to describe this entity. Two theories exist for the derivation of the term chorioretinitis sclopetaria.<sup>1</sup> Keeney proposed that the verb 'sclow' is an old English variant of 'sclaw' or 'claw' and sclopetaria characterizes the condition of scratching or clawing against the eye. Schoch believed that 'sclopetum' is a type of 'culverin', a 14th century Italian handgun.<sup>1</sup>

Fundus examination of sclopetaria demonstrates a fibroglial scar with sharp, serrated borders and pigment proliferation. The clinicopathologic features of sclopetaria include direct traumatic chorioretinal rupture followed by marked fibrovascular proliferation without retinal detachment.<sup>28</sup> A simultaneous retraction of the choroid and retina at the site of the break reveals bare sclera with proliferation of fibrous tissue. Despite the presence of full thickness retinal tear, retinal detachment is rare even without surgical intervention because firm chorioretinal adhesion develops at the edges of the lesion. Martin *et al*<sup>29</sup> describe successful management of seven of eight eyes with sclopetaria by initial observation only. The fact that a high percentage of patients with paintball injury present with a poor view of the fundus and also sclopetaria suggests that careful observation

with sequential B-scans may help distinguish retinal tear and detachment from sclopetaria.

Sclopetaria is a rare manifestation of ocular trauma with the largest published series of only eight cases.<sup>29</sup> To date, only a limited number of cases have been reported following a variety of injuries (Table 3).<sup>28–35</sup> Paintball injuries can cause anterior and posterior segment manifestations because of the unique form of injury the exploding gelatin pellets induce. It is important to recognize that 'soft' projectiles such as these can frequently induce sclopetaria even though they do not penetrate the orbit. Increased awareness and the need for proper ocular protection should also be emphasized by ophthalmologists.<sup>36</sup>

## References

- 1 Duke-Elder S, MacFaul PA. Injuries. Mechanical Injuries. In: Duke-Elder S (edn). *System of Ophthalmology*, Vol. 14, Part 1, C.V. Mosby Co.: St Louis, 1972, pp 158–160.
- 2 Easterbrook M, Pashby TJ. Eye injuries associated with war games. *Can Med Assoc J* 1985; **133**: 415–419.
- 3 Fineman MS. Ocular paintball injuries. *Curr Opin Ophthalmol* 2001; **12**: 186–190.
- 4 Fineman MS, Fischer DH, Jeffers JB, Buerger DG, Repke C. Changing trends in paintball sport-related ocular injuries. *Arch Ophthalmol* 2000; **118**: 60–64.
- 5 Ryan Jr EH, Lissner G. Eye injuries during 'war games'. *Arch Ophthalmol* 1986; **104**: 1435–1436.
- 6 Martin PL, Magolan Jr JJ. Eye injury during 'war games' despite the use of goggles. Case report. *Arch Ophthalmol* 1987; **105**: 321–322.
- 7 Moore AT, McCartney A, Cooling RJ. Ocular injuries associated with the use of airguns. *Eye* 1987; **1**: 422–429.
- 8 Easterbrook M, Pashby TJ. Ocular injuries and war games. *Int Ophthalmol Clin* 1988; **28**: 222–224.
- 9 Welsh NH, Howes F, Lever J. Eye injuries associated with 'war games'. *S Afr Med J* 1989; **76**: 270–271.
- 10 Acheson JF, Griffiths MF, Cooling RJ. Serious eye injuries due to war games. *BMJ* 1989; **298**: 26.
- 11 Pakoulas C, Shar S, Frangoulis MA. Serious eye injuries due to war games. *BMJ* 1989; **298**: 383.

- 12 Wellington DP, Johnstone MA, Hopkins RJ. Bull's-eye corneal lesion resulting from war game injury. *Arch Ophthalmol* 1989; **107**: 1727.
- 13 Mamalis N, Monson MC, Farnsworth ST, White Jr GL. Blunt ocular trauma secondary to 'war games'. *Ann Ophthalmol* 1990; **22**: 416–418.
- 14 Wrenn KD, White SJ. Injury potential in 'paintball' combat simulation games: a report of two cases. *Am J Emerg Med* 1991; **9**: 402–404.
- 15 Zwaan J, Bybee L, Casey P. Eye injuries during training exercises with paint balls. *Mil Med* 1996; **161**: 720–722.
- 16 Farr AK, Fekrat S. Eye injuries associated with paintball guns. *Int Ophthalmol* 1999; **22**: 169–173.
- 17 Thach AB, Ward TP, Hollifield RD, Dugel PU, Sipperley JO, Marx JL et al Ocular injuries from paintball pellets. *Ophthalmology* 1999; **106**: 533–537.
- 18 Kitchens JW, Danis RP. Increasing paintball related eye trauma reported to a state eye injury registry. *Inj Prev* 1999; **5**: 301–302.
- 19 Kruger LP, Acton JK. Paintball ocular injuries. *S Afr Med J* 1999; **89**: 265–268.
- 20 Otto MA, DePiero AD, Klein BL, Jaafar MS. Ocular injuries from paintball. *Am J Emerg Med* 2000; **18**: 744–745.
- 21 Hargrave S, Weakley D, Wilson C. Complications of ocular paintball injuries in children. *J Pediatr Ophthalmol Strabismus* 2000; **37**: 338–343.
- 22 Mason III JO, Feist RM, White Jr MF. Ocular trauma from paintball-pellet war games. *South Med J* 2002; **95**: 218–222.
- 23 Parker JF, Simon HK. Eye injuries due to paintball sports: a case series. *Pediatr Emerg Care* 2004; **20**: 602–603.
- 24 Greven CM, Bashinsky AL. Circumstance and outcome of ocular paintball injuries. *Am J Ophthalmol* 2006; **141**: 393.
- 25 Superstudy on Sports Participation. American Sports Data, Inc. SGMA International. Available at <http://www.americansportsdata.com>. Accessed May 10, 2006.
- 26 Conn JM, Annest JL, Gilchrist J, Ryan GW. Injuries from paintball game related activities in the United States, 1997–2001. *Inj Prev* 2004; **10**: 139–143.
- 27 Goldzieher W. Beitrag zur Pathologie der orbitalen Schussverletzungen. *Z Augenheilkd* 1901; **6**: 277–285.
- 28 Dubovy SR, Guyton DL, Green WR. Clinicopathologic correlation of chorioretinitis sclopetaria. *Retina* 1997; **17**: 510–520.
- 29 Martin DF, Awh CC, McCuen II BW, Jaffe GJ, Slott JH, Machemer R. Treatment and pathogenesis of traumatic chorioretinal rupture (sclopetaria). *Am J Ophthalmol* 1994; **117**: 190–200.
- 30 Asaria RH, Zaman A, Sullivan PM. Retinitis sclopetaria associated with airbag inflation. *Br J Ophthalmol* 1999; **83**: 1094–1095.
- 31 Katsumata S, Takahashi J, Tamai M. Chorioretinitis sclopetaria caused by fishing line sinker. *Jpn J Ophthalmol* 1984; **28**: 69–74.
- 32 Otto CS, Nixon KL, Mazzoli RA, Raymond IV WR, Aimbinder DJ, Hansen EA et al Chorioretinitis sclopetaria from BB *ex memoria*. *Ophthalmic Surg Lasers* 2001; **32**: 152–155.
- 33 Beatty S, Smyth K, Au Eong KG, Lavin MJ. Chorioretinitis sclopetaria. *Injury* 2000; **31**: 55–60.
- 34 Hart JC, Natsikos VE, Raistrick ER, Doran RM. Chorioretinitis sclopetaria. *Trans Ophthalmol Soc UK* 1980; **100**: 276–281.
- 35 Richards RD, West CE, Meisels AA. Chorioretinitis sclopetaria. *Am J Ophthalmol* 1968; **66**: 852–860.
- 36 American Academy of Pediatrics Committee on Sports Medicine and Fitness. Protective eyewear for young athletes. *Pediatrics* 2004; **113**: 619–622.