

# BJO

British Journal of Ophthalmology

## Editorial

### Penetrating injury of the eye

Penetrating injury of the eye<sup>1</sup> represents a major threat to vision in the workplace,<sup>2,3</sup> home,<sup>2,4</sup> school and playground, on the battlefield,<sup>5-8</sup> and in sport.

It represents not only a cause of severe visual loss but also a profound emotional trauma to patients and their families. Treatment is time consuming and expensive but despite this there is often a grave prognosis.<sup>4,9</sup>

Esmaeli *et al.*,<sup>4</sup> in a retrospective analysis of 176 cases of ruptured globe, found that predictors of a good (6/18 or better) visual outcome were a presenting acuity after injury of 6/60 or better, wound location anterior to the pars plana, a wound length of 10 mm or less, and a sharp mechanism of injury.

They concluded from their data that eyes with wounds longer than 20 mm, which extend posterior to the equator, will lead to poor final vision and subsequent enucleation in the overwhelming majority of cases, and that primary enucleation should be considered in eyes with such surgical findings.

However, in eyes with hand movement or better vision, short wounds (less than 10 mm) in the cornea or anterior sclera have a relatively good result. For these eyes careful initial wound repair and secondary vitrectomy should be performed. These findings should be borne in mind in discussions with patients their and families.

A study from Australia estimates the incidence of penetrating eye injury to be 3.6 per 100 000 of the population,<sup>10</sup> and Desai *et al.*, in this journal in 1996,<sup>11</sup> reported that the majority of hospital admissions for ocular trauma are in young male patients involved in accidents in the home.

In the military setting penetrating eye injury appears to be increasing. In the Crimean war the overall incidence of eye injury was reported as only 0.65% as a percentage of all injuries,<sup>12</sup> whereas in more recent conflict—for example, the Arab-Israeli wars of 1967, 1973, 1982<sup>6,13,14</sup> and the Gulf War of 1991,<sup>15,16</sup> show an incidence of 6.7–9.1%.

Unlike in peacetime the ocular injuries of war are bilateral in 15–25% of cases.<sup>13,17</sup>

This increasing incidence is probably due to the greater use of fragmentation weapons by the modern military, which has provided a strong stimulus for the development of high quality ocular protection. Cotter and La Piana<sup>18</sup> analysed the data from the Vietnam war and, using theoretical analysis, found that had the standard current US Army 2 mm thick defence goggle been worn, 52% of eye injuries would have been prevented. Projecting this fig-

ure to the Vietnam War overall, 5000 eye injuries from US and allied forces would have been prevented!<sup>19</sup>

In this issue of the *BJO* Uchio *et al.* (p 1106) present a computer model of the physical and mechanical conditions necessitating penetration of the globe using a system of finite element analysis.

The biophysics of missile injury to tissue is complex and difficult to study.<sup>20</sup> In general terms the injury to the tissue depends upon the kinetic energy of the missile, its shape and density, the angle and pattern of its flight, and the tissue characteristics of the “target”.

A penetrating injury of the globe is even more complex to study<sup>21,22</sup> as the initial energy of the missile strike produces a “shock wave” which rebounds from the ocular coats and the orbital wall.

Uchio *et al.*, using computer modelling software developed for the investigation of the physical behaviour of cars in simulated vehicle accidents, have explored a simulation of penetrating injury of the eye. This is a significant advance in our understanding of the biomechanics of ocular injury. Ocular protection and consequent prevention of eye injury represent a major breakthrough in trauma care. The increased utilisation of protective eyewear in the workplace has produced a decrease in eye injuries<sup>3,23</sup>; however, use of protective eyewear is far from universal.

While part of the reason for this is undoubtedly because of poor health education we have to question whether the worker can adequately see to perform his task through a dusty and scratched protective lens and whether the infantryman can adequately sight his weapon with the prismatic aberration induced by his ballistic eye protection.

To provide protection is one matter but to ensure a high compliance of wear is quite another. Research and development continues in the field of industrial, military, and sports eye protection. This, combined with a better understanding of the biomechanics of penetrating eye injury, meticulous primary microsurgical repair, and secondary closed intraocular microsurgery, should produce a reduction in visual loss secondary to penetrating eye injury.

PAUL McCORMACK

Princess Margaret Hospital, Swindon SN1 4JU

1 Kuhn F, Morris R, Witherspoon CD, *et al.* A standardised classification of ocular trauma terminology. *Graefes Arch Clin Exp Ophthalmol* 1996; 234:399–403.

2 MacEwen CJ. Eye injuries a prospective survey of 5671 cases. *Br J Ophthalmol* 1989;73:888.

- 3 Dannenberg A, Parver L, Brechner R, *et al*. Penetrating eye injuries in the workplace. The National Eye Trauma System Registry. *Arch Ophthalmol* 1992;110:843.
- 4 Esmaeli B, Elner S, Schark A, *et al*. Visual outcomes and ocular survival after penetrating trauma. *Ophthalmology* 1996;102:393-400.
- 5 Bellow JG. Observations on 300 consecutive cases of ocular war injuries. *Am J Ophthalmol* 1947;30:309.
- 6 Treister GA. Ocular casualties of the six day war. *Am J Ophthalmol* 1968;66:669-75.
- 7 Dalinchyuk MM. Damage to the eye in the case of mine injuries. *Voen Med Zeitschrift* 1989;8:28-30.
- 8 Hull FE. Management of eye casualties in the far east command during the Korean conflict. *Am J Ophthalmol* 1953;36:467-76.
- 9 de Juane J, Sternberg P Jnr, Michaels RG. Penetrating ocular injuries, types of injuries and visual results. *Ophthalmology* 1983;93:1318-22.
- 10 Fong LP. Eye injuries in Victoria, Australia. *Med J Aust* 1995;162:64-8.
- 11 Desai P, MacEwen C, Baines P, *et al*. Incidence of cases of ocular trauma admitted to hospital and incidence of blinding outcome. *Br J Ophthalmol* 1996;80:592-6.
- 12 Steindorf K. Dei kriegschirurgie des schorgans. *Berlin Klin Wochenschrift* 1914;51:1787-9.
- 13 Belkin M. Ocular war injuries in the Yom Kippur war. *J Ocul Ther Surg* 1983;2:40-9.
- 14 Belkin M, Triester G, Dohan S. Eye injuries and ocular protection in the Lebanon War 1982. *Isr J Med Sci* 1984;20:333-8.
- 15 Heier JS, Enzenauer RW, Wintermeyer SF. Ocular injuries and diseases at a combat support hospital in support of operations Desert Shield and Desert Storm. *Arch Ophthalmol* 1993;111:795-8.
- 16 Mader TH, Aragones JV, Chandler AC. Ocular and ocular adnexal injuries treated by United States military ophthalmologists during operations Desert Shield and Desert Storm. *Ophthalmology* 1993;100:1462-7.
- 17 Gombos GM. Ocular war injuries in Jerusalem. *Am J Ophthalmol* 1969;68:474-8.
- 18 Cotter F, La Piana FG. Eye casualty reduction for eye armour. *Mil Med* 1991;156:126-8.
- 19 Trediche TJ. Management of eye casualties in South East Asia. *Mil Med* 1968;133:355-62.
- 20 Ryan JM, Rich NM, Dale RF, *et al*, eds. *Ballistic trauma clinical relevance in peace and war*. Chapter 3. London: Arnold, 1997.
- 21 Tilbet CW, Rose HW, Herget C. High speed photographic study of perforating ocular injury by the BB. *Am J Ophthalmol* 1962;54:675-88.
- 22 Delori F, Pomerantzeff O, Cox MS. Deformation of the globe under high speed impacts, its relations to contusion injuries. *Invest Ophthalmol* 1969;8:290-301.
- 23 Karlson TA, Klein EK. The incidence of acute hospital treated eye injuries. *Arch Ophthalmol* 1986;104:1473-6.

### Contributors please note:

Communications from the **UK, Republic of Ireland, Australasia, Asia, Africa, Western Europe, Eastern Europe, Japan, the Middle East, the former Soviet Union, and Scandinavia** should be sent to the Editor, British Journal of Ophthalmology, Department of Ophthalmology, University of Aberdeen, Medical School, Foresterhill, Aberdeen AB25 2ZD, Scotland, UK (Tel: 01224 663812; Fax: 01224 663832).

Communications from the **USA, Canada, and South America** should be sent to Professor C Hoyt, Associate editor, University of California, UCSF Ophthalmology Department, Pediatric Ophthalmology, 400 Parnassus Avenue, Room 702 A, Box 0344, San Francisco, CA 94143, USA (Tel: +415 476 1289/1921; Fax: +415 502 6468).



## Penetrating injury of the eye

PAUL McCORMACK

*Br J Ophthalmol* 1999 83: 1101-1102  
doi: 10.1136/bjo.83.10.1101

---

Updated information and services can be found at:  
<http://bjo.bmj.com/content/83/10/1101.full.html>

---

*These include:*

### References

This article cites 20 articles, 6 of which can be accessed free at:  
<http://bjo.bmj.com/content/83/10/1101.full.html#ref-list-1>

Article cited in:  
<http://bjo.bmj.com/content/83/10/1101.full.html#related-urls>

### Email alerting service

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

---

### Topic Collections

Articles on similar topics can be found in the following collections

[Ophthalmologic surgical procedures](#) (971 articles)  
[Public health](#) (379 articles)

---

### Notes

---

To request permissions go to:  
<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:  
<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:  
<http://group.bmj.com/subscribe/>