

Traumatic injuries from foam Nerf bullets

BY BHAGASHREE JOSHI, MARIKA TROIANI AND MANOJ KULSHRESTHA

Background

Three patients are presented in this case report: an adult and two children which were subjected to ocular injuries from Nerf gun bullets. Generally, Nerf guns are considered safer than airsoft guns. While there are many papers on airsoft guns causing ocular injuries, there is little literature on Nerf gun injuries. Although these are commonly considered as children's toys, this article might change the opinion of experts and consider them as potential causes of ocular injuries [4-7].

Cases

First patient

An 11-year-old girl was shot in her left eye (LE) by her sibling at less than an arm's length. She arrived at the eye emergency of Leighton Hospital through A&E four hours after the episode.

1. Clinical signs

- No bleeding diathesis, clotting disorders, or sickle cell disease
- No conjunctival or scleral injury on anterior segment (AS) examination
- No other ocular problems before the incident
- Normal pupil reaction to light with no iridodonesis and no phacodonesis
- Absence of other medical disorders

- Best corrected visual acuity (BCVA) 6/6 in the right eye (RE); 6/12 in the LE (no improvement with "pinhole" (PH))
- Pain and blurring of vision in the affected eye
- Epithelial and stromal corneal oedema
- Fine epithelial oedema with Descemet membrane folds at the site of impact
- 1mm of hyphaemia in anterior chamber
- 16mmHg in both eyes (BE) via Goldman's applanation tonometry
- Posterior pole view was obscured due to the corneal oedema
- The B-scan showed a flat retina (no evidence of any vitreous haemorrhage, retinal tear, hole, or detachment).

2. Treatment

Mydriatic (G. Cyclopentolate 1% TDS)
Steroid drops (G. Dexamethasone 0.1%, six times per day).

Second patient

A 12 year old boy presented to the eye emergency service of Mid Cheshire Foundation NHS Trust with a right eye injury. The eye was hit by a Nerf gun pellet at a 3 metre distance 24 hours previously.

1. Clinical signs

- No bleeding diathesis, clotting disorders, or sickle cell disease
- No conjunctival or scleral injury on AS examination
- No drug allergy was noted
- No other ocular problems before the incident
- Painful sore eye
- BCVA 6/18 in RE; 6/12 in LE

- Small hyphaemia less than 1mm in the RE and 5-10 cells seen in the anterior chamber
- Intraocular pressure IOP measured through Goldman's applanation tonometry (GAT) was 11mmHg in both eyes
- A small retinal lesion, noted from subsequent follow-ups, was revealed to be a flat glial proliferation, an inflammatory response to the blunt trauma.

2. Treatment

Mydriatic (G. Cyclopentolate 1% TDS)
Steroid drops (G. Dexamethasone 0.1%, six times per day).

3. Results

He was under follow-up to observe the retinal anomaly and to check for angle recession.

Third patient

A 33-year-old lady presented to the eye casualty after being hit in the RE from two-metres distance by a Nerf gun pellet. The bullet hit the nasal side of the RE (Figure 1).

1. Clinical signs

- No bleeding diathesis, clotting disorders or sickle cell disease
- No drug allergy noted
- Medically fit and well
- No other ocular problems before the incident
- No obvious injury to conjunctiva, iris, lens, and sclera on AS examination

- BCVA 6/6 in RE; 6/5 in the LE (no improvement with PH)
- A retinal hole was temporally noted on fundus examination
- Anterior chamber was deep with no cells or hyphaemia.

2. Treatment

A laser retinopexy was performed.

3. Results

She was followed up seven weeks later: visual acuity of 6/6 in the RE. There was no evidence of retinal hole, subretinal fluid, or retinal detachment progression.

CASE REPORT

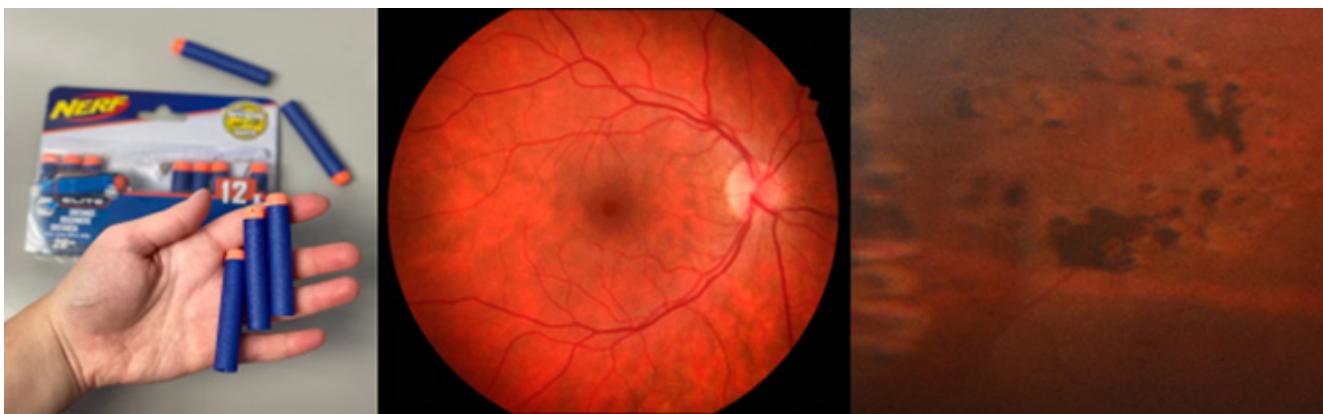


Figure 1: (left) Photo showing Nerf gun bullets; (middle) colour fundus photo of the right eye; and (right) supero-nasal retinal tear in the right eye.

Discussion

Eyes are the third most injured body part (1), but eye injuries differ according to appropriate treatments and visual outcomes (2). Usually, Nerf guns are considered a harmless, kid-friendly toy, but in this case series, the trauma was enough to cause hyphaemia, corneal oedema, and retinal abnormalities. In ages 5-14 years, 65% of injuries are sports related [3].

The current literature shows Nerf gun bullets, the projectile from the toy gun, are associated with traumatic hyphaemia [4], retinal detachment [5], and retinal dialysis [6], but a traumatic retinal hole has never been reported. Conversely, airsoft pellet guns have been presented as a cause of ocular injuries [7] (Figure 2), reporting 90% of these injuries occurring at home. Here, three different ocular injuries caused by a Nerf gun bullet are analysed.

The first child presented with a traumatic hyphaemia in less than one third of the anterior chamber, in line with most of the reports associated with blunt trauma [8] and corneal injury [9]. The second case, the boy, presented a vitreoretinal interface glial abnormality, developed one month after the impact – this child presented with corneal oedema with hyphaemia, an index of high-velocity injury. And the third case, the adult, had a retinal hole following the injury with a Nerf gun bullet.

In a study evaluating ocular injuries in projectile impacts, they found retinal avulsion at kinetic energy of 1.20Nm and retinal tear at 1.69Nm in porcine eye models [10]. However, Nerf guns would enable the projectile to reach a kinetic energy of 1.92Nm, enough to cause both anterior and posterior segment injury and permanent vision loss [6].

W work
F Force of impact
d distance
m mass
v velocity

$$W = Fd = \frac{1}{2}mv^2$$

A large range of bullets can be used in Nerf guns. In this instance, those blue coloured with an orange tip were used (Figure 1). Their mass is 1.02g and diameter 1.27cm. The velocity these are fired at was 35mph. This would give a force of impact at 1m of 0.125 N. An 8g air gun pellet with a muzzle velocity of 600mps would create an impact force of 2.4 N at 1m, causing a penetrating injury. A small paintball of 3g, painful on skin if fired at 90mps at 1m and a force of 12.15 N, could cause a severe ocular injury such as hyphaemia, anterior uveitis, retinal holes, or detachment. This is a reason to protect eyes by wearing helmets during use.

Conclusions

This case series would add Nerf gun bullets as potential causes of ocular injuries, mostly in children. We would recommend that if sold, they came with safety goggles to wear to protect the eyes from a sports related injury.

References

1. Nordberg E. Injuries as a public health problem in sub-Saharan Africa: epidemiology and prospects for control. *East Afr Med J* 2000;77(12 S.):S1-S43.
2. Ashaye AO. Traumatic hyphaema: a report of 472 consecutive cases. *BMC Ophthalmol* 2008;8:24.
3. MacEwen CJ, Baines PS, Desai P. Eye injuries in children: the current picture. *Br J Ophthalmol* 1999;83(8):933-6.
4. Birzrah M, Verma S. Nerf gun eye injuries: traumatic hyphaema. *BMJ Case Rep* 2017;2017:bcr2017220967.
5. Mandviwala MM, Sassani PP. Traumatic Retinal Detachment Caused By Nerf Gun Shot In a Pediatric Patient. *Retin Cases Brief Rep* 2019;10. [ahead of print]
6. Henry T, Palakkamanil M, Rubin U, Tennant M. Traumatic retinal dialysis resulting from Nerf foam bullet. *Can J Ophthalmol* 2019;54(3):e100-2.
7. Kennedy EA, Ng TP, Duma SM. Evaluating eye injury risk of Airsoft pellet guns by parametric risk functions. *Biomed Sci Instrum* 2006;42:7-12.
8. Luksza L, Homziuk M, Nowakowska-Klimek M, et al. Krwawienia do komory przedniej oka jako następstwo urazów mechanicznych gatki ocznej [Traumatic hyphema caused by eye injuries]. *Klin Oczna* 2005;107(4-6):250-1.
9. Rocha KM, Martins EN, Melo LA Jr, Moraes NS. Outpatient management of traumatic hyphema in children: prospective evaluation. *J AAPOS* 2004;8(4):357-361.
10. Scott WR, Lloyd WC, Benedict JV, Meredith R. Ocular injuries due to projectile impacts. *Annu Proc Assoc Adv Automot Med* 2000;44:205-217.



Figure 3: Illustrative photo to show how effective and dangerous an airsoft pellet gun can be. The bruise might take up to one month to fully heal.

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	NERF GUN	PAINTBALL	AIRSOFT
m(g)	1.02	3	8
v(m/s)	15.64	90	600
F(N)	0.125	12.15	2.4

Figure 2: The equation showing the force of impact (N) in relation to diameter, mass (g), and velocity (v) of the gun's bullet.