

Clinical Profile and Outcome of Ocular Shotgun Pellet Injury Over 13 Years

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Abstract

Background: Ocular trauma is a major preventable cause of visual morbidity and a leading cause of monocular blindness. Pellet injury is one of the causes of major ocular trauma. It needs extensive medical care and vocational rehabilitation. It has significant impact on global health

Methods: This retrospective study was conducted from medical records of 25 patients with ocular pellet gun injury admitted in National Institute of Ophthalmology and hospital, Dhaka from 2011 to 2023.

Results: Out of the 25 patients, 13 (52.0%) were more than 25 years age group while the mean age of the patients was 25.5 (± 4.6) years. All of the patients were male. Among them 23 (92.0%) had unilateral eye involvement. Pellets caused perforating injuries in 12 (44.4%) eyes while in 9 (33.3%) eyes had closed globe injury. Vitreous hemorrhage in 21 (77.8%) eyes, retinal hemorrhage in 16 (59.3%) eyes, retinal tear in 15 (55.6%) eyes, while few (7.4%) had macular injury and 4 (14.8%) eyes suffered from traumatic optic neuropathy Majority of the eyes (15;55.6%) underwent PPV while 12 (44.4%) eyes were managed by conservative management. At baseline, only one eye (3.7%) had visual acuity 6/60 or better. Sixteen eyes (59.3%) had visual acuity $<1/60$ and 8 eyes (29.6%) had NPL. Six months after treatment, two eyes (7.4%) had visual acuity 6/60 or better. Visual acuity was $<1/60$ in 7 eyes (25.9%) while 17 eyes (63.0%) had NPL. Finally, sixteen eyes (59.3%) developed phthisis bulbi while 3 (11.1%) eyes were normal.

Conclusion: This study highlights the bad impact of pellet injury to the society due to poor visual and anatomical outcomes despite of immediate surgical intervention. Protective eyewear should be used during wartime and protests and decision makers should ban use of pellet gun on the civilians.

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Introduction

Ocular trauma is a major preventable cause of visual morbidity and a leading cause of monocular blindness.¹ It needs extensive medical care and vocational rehabilitation. It has significant impact on global health. Productivity and livelihood are also lost in ocular trauma. According to the World Health Organization (WHO), 55 million eye injuries that limit activities for more than one day occur annually. Approximately 19 million and 3.9 million people are blind due to ocular injuries in one or both eyes respectively.² Ocular injuries can be classified etiologically into domestic, road traffic accidents, iatrogenic, occupational, war injuries, sports, fights and assaults.³ Ocular shotgun injuries constitute a small number of ocular trauma. Shotgun is considered as a nonlethal weapon which is used to control agitated mobs by the home security forces. It was first used in the 1970s to control civil unrest in Northern Ireland. Recently over the last few years in Kashmir (India) pellet guns has been used to control protesting mobs. Pellet injuries are unique because injuries are mostly perforating injuries and an eye can be injured by one or multiple pellets. Ocular injuries are associated with other body parts injury by the pellets. The study was conducted to determine the pattern and outcome of gun pellet ocular injuries in Bangladesh.

Methods

A retrospective study was conducted to evaluate consecutive patients with ocular pellet injury over a 13-year period from 2011 to 2023. The study was conducted in accordance with the Declaration of Helsinki and the study protocol was approved by the ethical committee of National Institute of Ophthalmology and Hospital, Dhaka. Only the patients who had ocular injury with pellet with or without retained intraocular pellet and had at least 6 months of follow-up were included in this study. The patients with history of any other ocular trauma, surgery or disease were excluded

from this study. Patients with incomplete medical records were also excluded.

All patients underwent detailed history of trauma and complete ophthalmological examination at the presentation, including measurements of Snellen best-corrected visual acuity (BCVA), and slit-lamp biomicroscopy. Gentle B scan, X-ray orbit in foreign body protocol, color fundus photography and indirect ophthalmoscopy were performed in appropriate cases. The exact localization of pellets was confirmed by computed tomography (CT) imaging scan before operation. Entry wounds location for pellets were categorized according to the most posterior extent of the wound; zone I (a wound limiting within the cornea and limbal area), zone II (a wound involving the anterior 5 mm of the sclera), and zone III (a wound extending more than 5 mm posterior to limbus).⁴ All the surgeries were performed by a team consisted of trained corneal and vitreoretinal surgeons of the hospital. The patients were operated under general anesthesia. The pellet was mobilized and removed with intraocular round foreign body removal forceps after enlargement of sclerotomy wound. After pellet removal retinal breaks related to the IOFB injury was treated with endolaser photocoagulation. Silicone oil tamponade was given at the end of surgery in patients with concomitant RD, retinal injury and preoperative surgeon's discretion. Simultaneous corneal and/or cataract surgery was performed when necessary.

To identify the probable predictive factors associated with final visual outcomes in patients with ocular pellet injury, the clinical data were statistically analyzed. The statistical analysis was conducted using SPSS (Statistical Package for the Social Science) version 26 statistical software. Clinical variables evaluated for association with visual outcomes included the following: age of the patients; location and size of wound, initial VA, type and

extent of injury and presence of retinal tear. The findings of the study were presented by frequency, and percentage in tables. Means and standard deviations for continuous variables and frequency distributions for categorical variables were used to describe the characteristics of the total sample.

Results

Out of 25 patients, majority of the patients (13; 52.0%) were in more than 25 years age group while the mean age of the patients was 25.5 (± 4.6) years. All of the patients were male. In most of the cases (23; 92.0%), involvement of one eye was observed (Table I). Entry site was absent in 10 (37.0%) eyes while zone II was involved in 13 (48.1%) cases. Pellets caused perforating injuries in 12 (44.4%) eyes while in 9 (33.3%) eyes it was closed globe injury. More than one third (10; 37.0%) eyes had hyphaema.

Vitreous hemorrhage was found in 21 (77.8%) eyes while 16 (59.3%) eyes had retinal hemorrhage. Retinal tear was observed in 15 (55.6%) eyes while few (7.4%) had macular injury. Four (14.8%) eyes suffered from traumatic optic neuropathy (Table II). Majority of the eyes (15; 55.6%) underwent Parsplanavitrectomy while 12 (44.4%) eyes were managed by conservative management (table 3). At baseline, only one eye (3.7%) had visual acuity 6/60 or better. Sixteen eyes (59.3%) had visual acuity $<1/60$ and 8 eyes (29.6%) had No PL. Six months after treatment, two eyes (7.4%) had visual acuity 6/60 or better. Visual acuity was $<1/60$ in 7 eyes (25.9%) while 17 eyes (63.0%) had No PL (Figure 1). Finally, sixteen eyes (59.3%) developed phthisis bulbi while 3 (11.1%) eyes were normal (Figure 2).

Table I: Baseline characteristics of the patients (n=25)

Baseline characteristics	Frequency (%)
Age group (in years)	
Up to 25	12 (48.0)
> 25	13 (52.0)
Mean \pm SD	25.5 \pm 4.6
Male Gender	25 (100.0)
Eye involvement	
One Eye	23(92.0)
Both Eye	2(8%)

Table II: Clinical features at presentation (n=27)

Clinical features	Frequency (%)
Entry site	
Absent	10 (37.0)
Zone I	3 (11.1)
Zone II	13 (48.1)
Zone III	1 (3.7)
Type of injury	
Penetrating	6 (22.2)
Perforating	12 (44.4)
Closed globe	9 (33.3)
Location of pellet	
Orbital	15 (55.6)
Within eyeball	7 (25.9)
Within sclera	5 (18.5)
Anterior chamber findings	
Hyphema	10 (37.0)
Lens injury	5 (18.5)
Iris injury	5 (18.5)
Posterior segment findings	
Vitreous hemorrhage	21 (77.8)
Retinal hemorrhage	16 (59.3)
Retinal tear	15 (55.6)
Macular injury	2 (7.4)
Traumatic optic neuropathy	4 (14.8)

Table III: Treatment modalities of injured eyes (n=27)

Treatment modalities	Frequency (percentage)
Par planavitrectomy	15 (55.6)
Conservative management	12 (44.4)

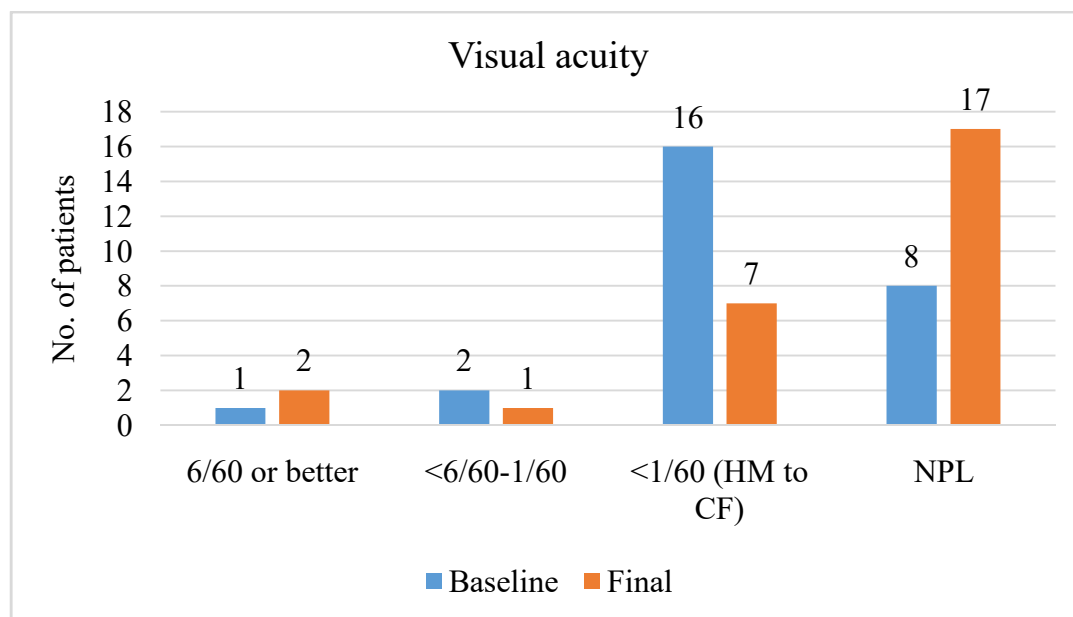


Figure 1. Distribution of patients by visual acuity (n=27)

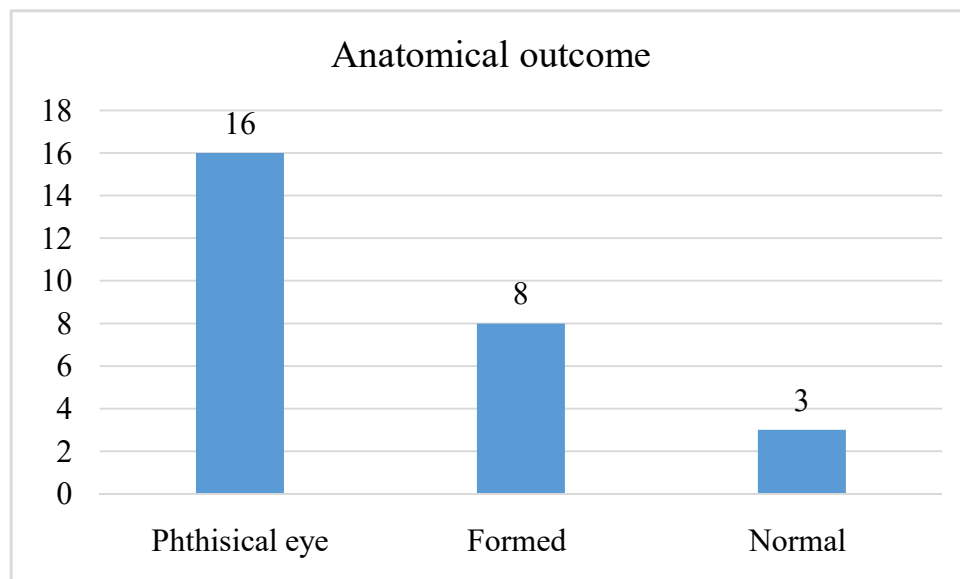


Figure 2. Anatomical outcome of the patients after six months of treatment (n=27)

Discussion

Pellet gun is one of the cheapest and most widespread air gun. Compressed air or gas is used to propel the projectiles from pellet guns.⁵ A single pellet gun cartridge breaks into more than 500 small iron pellets. A standard pellet gun bullet weights 0.345 g and enters the globe at average speed of about 72 meter/second. The critical velocity for penetration of human skin by an air gun pellet is between 38 and 70 m/sec (125–230 ft/sec). These small metal pellets have the power to penetrate through the skin, entire globe, and even the orbital bones.⁶ The ability of shotgun pellets to perforate or damage the globe depends on the striking energy which in turn is related to factors like distance, temperature, powder load, shot size, shot weight, and gauge. A retrospective case series of 36 patients in the USA reported that brain, eye, head, and neck were the most common sites of pellet injury.⁷

Typical gun pellet casualties occur in young males.⁸ In our study of the 25 patients all were males and 52% of those injured were above the age of 25 years with mean age 25.5 (+/- 4.6)

years. This was due to the fact that these agitated mobs comprised primarily of young males. Ocular injuries are more in young male even in the civilian setting. Xinwei et al.⁹ found more than 90% young males under 30 years (90.3%) in a series of 777 pellet injury in Kashmir. Another study from Kashmir reported 19 out of 20 were males and 1 was female; 75% of those were below the age of 23 years.⁸ Monocular injury occurred in majority (92%) of the cases in this study while a small fraction of the patients sustained binocular injury which was similar to the study by Xin Wei et al.⁹ who found monocular injury 94.3%. On the other hand, Korobelnik et al.¹⁰ reported 31.9% of 160 pellet gun binocular injury in a 5-years retrospective case series in France. The higher incidence of binocular injury in this French study might be a result of the circumstances of injury which was the use of pellet gun deliberately during a fight in 85% of the cases. Another French study reviewed 15 years of pellet gun-related ocular injuries and postulated that gun shooting at longer range frequently resulted in binocular trauma due to scatter of

pellets, while shooting at close range generated lid, conjunctiva and powder cornea tattoos.¹¹

The majority of the patients (66.6%) in our study had open globe injury. Among them 12 (44.4%) had perforating injury. Due to high speed and small size, pellets most commonly result in penetrating or perforating globe injury with or without retained intraocular or intraorbital foreign body. High percentage of open globe injury (50- 78%) were reported in review of similar articles.^{8,12} Pellets were found mostly within orbit (55.6%) while intraocular pellets were also present in high percentage (44.4%) in our study. This is due to more cases of perforating injury in our series. Retained intraocular pellets ranged from 50- 83% in different studies which is in accordance with our study.^{5,13,14} PPV was done in 55.6% of cases in our study. Badly injured cases were treated with primary repair/ enucleation which is the main cause of low rate of PPV in spite of high penetrating/perforating injury (66.6%). This is in line with the study performed by Khoueiret al.¹³ and Tabatabaei SA et al¹⁴ who reported that 50% and 31.5% respectively of their patients needed combined lensectomy and vitrectomy.

The most common clinical features observed in our study were vitreous hemorrhage followed by retinal haemorrhage and retinal tear. In our study lens injury, hyphema, iris injury and traumatic optic neuropathy occurred in 18.5%, 37%, 18.5% and 14.8% patients, respectively. In a retrospective case series of 777 patients from July to November 2016 in Srinagar, India, ocular injuries documented to have occurred from pellet guns included vitreous haemorrhage, hyphaema, traumatic cataract and RD.⁹ In a series of 105 air gun pellet-related ocular injuries in a civilian setting, 18% underwent enucleation and 23.8% had poor vision due to retinal damage, cataract formation, VH, choroidal tear or optic nerve damage.¹⁵

The prognosis for penetrating eye injury is poor. More than 90% had poor vision, <6/60. PL after conservative or surgical treatment. At the end of 6 months more than 30% patients loose light perception and only 7.4% patients had vision better than 6/60. Large number of eyes become phthisical (60%) and 30% eyes were maintaining normal consistency with silicon oil inside. In our study factors associated with a poor visual outcome included perforating injury, badly injured disorganized eye at presentation, retinal tear, macular injury, retained IOFB, and traumatic optic neuropathy. Significant ocular morbidity with poor visual prognosis was similarly reported by Xin Wei et al.⁹ where more than 80% of injured eyes had an initial BCVA of CF or worse. The 2010 Kashmir study included 60 patients reporting initial BCVA and ocular trauma score (OTS). BCVA of HM or worse was noted in 61.6% of eyes.¹² No significant relation between final vision and initial nature of trauma, zone of injury or initial vision could be established except retinal tear ($p < 0.039$).

Conclusion

Visual and anatomical outcomes remained poor in spite of immediate surgical intervention in most of the cases because of extensive damage of the eyeball. Visual rehabilitating surgery was inappropriate in large number of badly injured cases. Our study showed that pellet gun-related ocular injuries resulted in significant morbidity. Both individuals and the society suffer from physical, emotional, and socio-economic trauma due to poor visual outcomes, high cost medical care and long-term visual rehabilitation process in these productive age group. Military eye protective wear which is compulsory to use during warfare is effective in reducing ballistic or pellet-related injury.¹⁶ Eye protective spectacles by civilians in regions where security forces utilize pellet guns may reduce the incidence of such injuries. This study will highlight the bad impact of pellet injury to the

society and thus to motivate the decision makers to ban use of pellet gun on the civilians

Limitation of the Study

The limitation is retrospective design of the study due to the emergency nature of the event. The victims in this study were young males who sustained open globe injuries.

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