Original Research Article

Pattern and visual outcomes of ocular fire-cracker injuries during Diwali festival in a tertiary Care Hospital in North India

Pallavi Sharma[1], Anu Radha Bharti[2], Sachit Mahajan[3*]

[1]Senior Resident, Department of Ophthalmology, Government Medical College, Jammu, Jammu and Kashmir, India

[2]Senior Resident, Department of Ophthalmology, Government Medical College, Jammu, Jammu and Kashmir, India

[3]Senior Resident, Department of Ophthalmology, Government Medical College, Jammu, Jammu and Kashmir, India

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Abstract

Background: The firecrackers are used widely during Diwali. Eyeball is one of the most commonly injured organ in firecracker injuries. The fire-crackers can cause irreparable damage to ocular structures, leading to blindness. This study was conceptualized to study the pattern of injuries resulting from fire-cracker use and their visual outcomes, in order to generate evidence for managing these injuries more effectively. **Material and Methods:** This longitudinal, descriptive study was carried out over a period of one week during Diwali festival in 2019, in a tertiary care teaching hospital in North India in 21 patients who presented to hospital with ocular injuries caused by firecrackers. Visual acuity was recorded and complete slit lamp examination, non-contact tonometery, and gonioscopy was done. Ultrasound B-scan and X-ray were also done, when required. **Results**: The mean age in our study was 18.42±11.88 years with age range of 7-57 years. There were 20 males and 1 female in the study. Most of the injuries were caused by bombs and sparkles. Most of the patients (50%) had visual acuity in range of 6/6-6/24 at the time of presentation. Conjunctival surface was involved in all the patients, followed by lids and cilia (59.09%). One patient had corneal perforation with uveal tissue proplase.Six patients had vitreous haemorrahge and seven patients had hyphema. Final visual outcome was favorable with 63.64% patients achieving vision of 6/6- 6/24 at the end of six weeks. **Conclusion**: Severe injuries can lead to permanent loss of vision or decreased vision from squealae of wound healing such as astigmatism. Hence, stricter implementation of existing laws and regulations, public education and awareness is needed to prevent avoidable blindness resulting from use of fire crackers.

Key words: Eye injury, corneal injury, hyphema, vitreous hemorrhage.

Introduction

India is vast country with many traditions and festivals, and fire crackers are used widely as a part of their celebration. The firecrackers are used widely during Diwali, an important annual Hindu festival. As a part of Diwali celebration, lamps are lighted and fire-crackers are burnt. Fire-crackers are widely available in India and each individual can burn these fire-crackers in the way he/she desires. The difference in use of fire-works during festivals in India and in developed countries is because of existing legislation regarding use of fire-works in developed countries.

Fire-crackers can lead to ocular injuries. Studies have shown that eyeball is one of the most commonly injured organ in firecracker injuries[1-3]. Both superficial and deep ocular structures, in addition to peri-ocular structures, can be involved in injuries caused by fire-crackers. The fire-crackers can cause irreparable damage to ocular structures, leading to blindness[4]. Firecracker related injuries are an important cause of preventable blindness[5]. Special emphasis has been given in Vision 2020 to prevent avoidable blindness[6]. Hence, every attempt should be made to prevent these injuries and resulting blindness specially in children as visual impairment in children can cause financial burden to the family.

*Correspondence
Dr. Sachit Mahajan
Senior Resident, Department of Ophthalmology, Government Medical College, Jammu, Jammu and Kashmir, India
E-mail: mahajansachit1992@gmail.com

Though the fire-cracker injuries have decreased over the past few years but still some emphasis is needed to create awareness among the general public regarding the injuries caused by these fire-crackers. The main objective of this study was to study the pattern of injuries resulting from fire-cracker use and their and visual outcomes during the annual Diwali festival, in order to generate evidence, which would help us in managing these injuries more effectively.

Material and Methods

This longitudinal, descriptive study was carried out over a period of one week during Diwali festival in 2019 in the month of October, in a tertiary care teaching hospital in North India, after obtaining ethical clearance from Institutional Ethics Committee. Twenty one patients who presented to the emergency room and out-patient clinic of department of ophthalmology with firecracker injuries during the Diwali festival were included in the study. A written informed consent was taken from each patient after explaining them the purpose of study.

A detailed history was taken and complete ocular examination was done. Visual acuity was recorded with Snellen visual acuity chart and Cardiff acuity chart or picture chart, according to the age of the patients. A detailed slit lamp examination was done to evaluate anterior segment. Intra-ocular pressure measurement was done using non-contact tonometer. Gonoioscopy was done using Goldmann 3 mirror indirect gonio-lens. Fundus was evaluated using 90 D slit lamp biomicroscopy and indirect ophthalmoscope. Ultrasound A-sacn and B-scan and X-ray were also done, when required, to rule out intra-

ocular foreign bodies, vitreous hemorrhage and retinal detachment in cases, where fundus was not visible.

The injuries were classified according to the Birmingham Eye Trauma Terminology System (BETTS). The patients were managed according to the injury. The patients were followed-up for a period of six weeks. At the end of six weeks, final visual outcome was analysed, Intra-ocular pressure was measured and fundus examination was done with indirect ophthalmoscope.

All the data was entered in Microsoft excel and subsequently analyzed. The data was expressed as percentages and proportions.

Results

The mean age in our study was 18.42±11.88 years with age range of 7-57 years. There were 20 males and on 1 female in the study. The age distribution is shown in table 1. Majority of the patients (66.7%) were less than 20 years of age, out of these 10 patients (47.61%) were under 10 years of age. 5 patients (23.81%) were in the age group of 21-25 years and only 2 patients (9.53%) were >25 years of age.

Table 1 : Age Distribution Of Patients

Age	N	Percentage
5-10 years	5	23.81%
11-15 years	5	23.81%
16-20 years	4	19.04%
21-25 years	5	23.81%
>25 years	2	9.53%
Total	21	100%

Type of fireworks causing injuries in shown in Figure 1. The majority of fire-crackers casuing injuries were bombs (43%), followed by sparkles (24%), flower pots (19%) and rockets (14%).

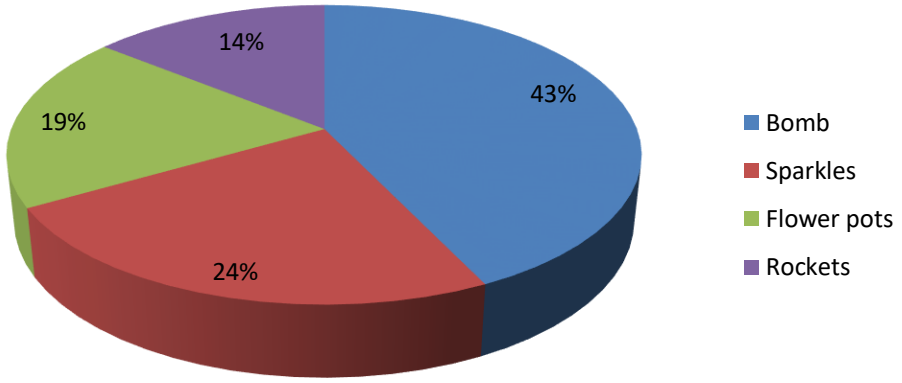

Figure 1- Causes of ocular Injuries

The visual acuity at the time of presentation, of 22 involved eyes of 21 patients is shown in table 2. Most of the eyes (50%) had good visual acuity at the time of presentation (6/6- 6/24). Only 8 patients had visual acuity <6/60, out of which one patient had no perception of light at intial presentation, 1 patient had visual acuity between 6/60 to Counting fingers (CF) and 6 patients (27.27%) had visual acuity between CF to perception of light (PL).

Table 2 : Visual Acuity At The Time Of Presentation

Visual Acuity	N	Percentage
6/6 – 6/24	11	50.00%
6/36- 6/60	3	13.64%
6/60 – Counting fingers	1	4.54%
Counting fingers- PL	6	27.27%
No PL	1	4.54%

PL= Perception of light

Out of 21 patients in the study, thirteen patients received injuries, being actively involved in fire-works, while 8 patients were on-lookers. As evident from table 3, conjunctiva was involved in all the patients. Conjunctival involvement manifested in the form of conjunctival congestion, subconjunctival haemorrhage and presence of soot particles within the conjunctival layers. Involvement of lids and cilia manifested in the form of burns on lids and cilia, as lacerations of lids and periorbital edema. Corneal abrasions were diagnosed on slit lamp by flourescein staining with sterile flourescein strips. Twelve patients (54.54%) had corneal abrasions on presentation. One patient had penetrating injury with corneal perforation, uveal prolapsed, vitreous hemorrhage and retinal detachment. Out of seven patients with hyphema, six patients had full chamber hyphema and 1 patient had grade 2 hyphema. Out of 6 patients with vitreous hemorrhage, majority (4 patients) had grade 2 viterous haemorrhage and 2 patients had garde 3 vitreous haemorrhage. There were no cases of any intra-ocular foreign body or endophthalmitis at the time of presentation.

Table 3 : Spectrum Of Ocular Injuries

Structure Involved	N	Percentage
Lids and cilia	13	59.09%
Conjunctiva	22	100%
Cornea (abrasions)	12	54.54%
Corneal perforation	1	4.54%
Hyphema	7	31.81%
Vitreous hemorrhage	6	27.27%

All the patients were managed according the type and severity of injury. Saline wash, antibiotics and cycloplegics were mainstay of treatment. Lacerations involving lids were sutured with 6’0 silk sutures over skin and 6’0 vicryl sutures over muscles and deeper structures. Patients having soot particles on conjunctival surface were given saline wash and soot particles were removed with non-toothed forceps. Seven patients were admitted in hospital and rest of the patients were managed on out patient basis. One patient underwent repair of corneal perforation and rest six patients were managed conservatively. After the repair of corneal perforation, patient was subsequently put on topical antibiotic steroid drops, topical cycloplegics, oral antibiotics and oral steroids. Patient was discharged on third day of admission. Patients with hyphema were managed with bed rest with head elevation at 45 degrees, topical steroids, cycloplegics, antiglaucoma drugs and oral steroids. Patients with corneal abrasions were managed with pad and bandage with topical cyloplegic and antibiotic ointment for one day and were subsequently

put on topical lubricants, cycloplegics and antibiotic ointment. Corneal abrasions healed over a course of 1- weeks in all the patients. Patients having high intra-ocular pressure, were put on anti-glaucoma medications according to the intra-ocular pressure. Patients with intra-ocular pressure in the range of 21-30 mmhg were put on topical anti-glaucoma medications, while patients with IOP >31 mmhg were given oral medication in addition to topical anti-glaucoma drugs. Patients with vitreous haemorrhage were managed conservatively with observation only. All the patients were followed-up for a period of six weeks.

The final visual outcomes of these patients at the end of six weeks is presented in table 4. Majority of the patients (63.64%), achieved visual acuity >6/24 and 31.82% patients had visual acuity between 6/36-6/60. Only 1 patient who presented with no perception of light had visual acuity of <6/60.

Table 4 : Final Visual Outcomes Of Patients

Visual Outcomes	N	Percentage
6/6- 6/24	14	63.64%
6/36- 6/60	7	31.82%
<6/60	1	4.54%

Discussion

Firecarckers find a special place in the celebration of major religious festivals and national events due to their sound, sparkles and sudden burst of colors. They are widely used during the Diwali festival in India. Fireworks remain a major cause of injuries at the time of Diwali[7]. Despite the regulations imposed on use of fireworks, there has been a failure on reducing the firework related injuries[8]. In a culturally diverse country like India, pattern of injuries varies from place to place, thus it becomes important to study the injuries caused by the use of fire-crackers.

In the present study, involving 21 patients, who presented to the out patient clinic and emergency of ophthalmology department, most of the patients were males, with only one female. This is consistent with studies of Chakraborti C et al, 76.7% males[9], Gupta H et al, 73.68% males[10], and Adenuga OO et al, 81% males[11]. Predominant male involvement in various studies could be attributed to their greater involvement in bursting fire-crackers as well as involvement in outdoor activities. Due to their greater involvement, they are more likely to be injured while igniting fire-crackers.

Majority of the injuries (66.67%) occurred in patients below 20 years of age in our study. 10 patients (47.61%) were under 10 years of age, 5 patients (23.81%) were in the age group of 21-25 years and only 2 patients (9.53%) were >25 years of age. Children were more involved in fire-cracker injuries as compared to other age groups. This is also consistent with other studies, such as Kuhn et al, who reported 61% injuries in children[12]. Other studies have also reported similar findings[13-16]. Children are more susceptible to injuries by fireworks because of their curiosity towards colorful fireworks and inability to anticipate danger and act decisively during dangerous situations. Most of the children who received ocular injuries, were involved in igniting firecrackers without any adult supervision. Visual impairment in children can have major impact on parents and family in terms of treatment expenses, hospital stay and loss of school days, which can lead to mental as well as financial burden. Children should not allowed be allowed to ignite fire-crackers without any adult-supervision.

Most common causes of injuries were bombs (43%) and sparkles (24%) followed by flower pots (19%) and rockets (14%). This is similar to study by Kumar R et al, who reported bombs (37%) and sparkles (19%) as the most common cause of injury[17]. Whereas Gupta H et al, reported bombs (37%) and flowerpots (31.5%) as the most common causes of injuries[10]. Faulty crackers were an important cause of injuries. Although most of the patients, who sustained injuries were directly involved in igniting fire-crackers, but 8 patients who sustained injury, in our study, were on-lookers. Various studies have also reported injury to on-lookers during bursting fire-crackers[7]. Negligent behavior during igniting the fire-crackers, not wearing protective equipment, was most the common cause of accidents both in children and adults.

The ocular injuries caused by fire-crackers vary in severity and presentation. Most of the patients (50%) had good visual acuity at the time of presentation (6/6-6/24), in our study. Only 8 pateints (38.09%) patients had visual acuity <6/60, one patient had had no perception of light at the time of presentation to the hospital and 7 patients (31.82%) had visual acuity between counting fingers to perception of light (Table 2). Similar findings have been reported in various studies. Gupta H et al, reported that 56% patients had visual acuity of >6/12, 20% patients had visual acuity of 6/12-6/60, 4% patients had visual acuity of 6/60 –Counting fingers, 12% patients had vision between hand motions to perception of light and 2 patients had no perception of light[10]. Kumar R reported that two eyes of two patients had no perception of light, 13 eyes of 11 patients had visual acuity of hand movement to perception of light while eight patients had counting fingers to 6/60 vision[17].

With regards to spectrum of ocular injuries, two patients had burnt cilia, 5 (23.80%) patients had lacerations of lids, 13 (59.09%) patients had edema of lids, one patient had subconjunctival hemorrhage and one patient had traumatic mydriasis at the time of presentation along with other injuries in our study. One patient had corneal perforation with prolapse of uveal tissue, vitreous haemorrhage and retinal detachment. Twelve patients (54.5%) patients had corneal abrasiosn, seven patients (31.82%) had hyphema and six patients (27.27%) had vitreous haemorrhage. (Table 3) Gupta H et al, reported periocular burns in all the patients, corneal abrasions in 74% patients, corneal perforation and hyphema in 16%, globe rupture, lid and conjunctival lacerations in 11% and iridodialysis and hyphema in 5%[10]. Similarly, Adenuga OO et al, reported hyphema in 42.1%, vitreous hemorrhage in 28.9%, traumatic cataract in 24.6% and traumatic iritis in 18.4%. There were three eyes with an intraocular foreign body and one with a ruptured globe, in their study[11]. Arya SK et al, reported corneal abrasions in 38.5% patients, multiple corneal foreign bodies in 35.7% patients, hyphema in 33.3% patients, lid and conjunctival burns in 11.9% patients, vitreous haemorrhage in 9.5 % patients and Open globe injury in 7.1% patients[7]. There is a wide spectrum of ocular fire-cracker injuries. Both superficial as well as deep ocular structures can be involved, depending upon the mechanism of injury.

The final visual outcome depends upon several factors such as time to presentation, severity of injury, initial visual acuity, presence of intra-ocular foreign body, retinal detachment, and endophthamitis. All the patients presented to the hospital within 12-24 hrs after injury, in our study. Most of the patients were managed conservatively on out-patient basis and only seven patients were hospitalized, in our study. The final visual outcomes were favorable with 63.64% patients achieving a final visual acuity of 6/6- 6/24. One patient with corneal perforation had visual acuity of no perception of light at final visit in our study and 31.82% patients had visual acuity between 6/36-6/60. Adenuga OO et al, reported 68% patients achieving vision of >6/18 and 15% patients with final vision of 6/18-6/60[11]. and Arya SK et al reported that 29 (69%) patients had visual acuity of 6/6 to 6/9; seven (16.6%) patients had 6/18; three (7.1%) patients had 6/60 vision and two (4.9%) patients had 6/36 vision, One (2.3%) patient lost his eye completely due to ruptured globe and this eye was enucleated in their study[7].

The firecracker injuries can have a tremendous impact on the quality of life. They affect both physical as well as mental health of a person. Patients have facial and peri-ocular burns can have low self-esteem in the society. Sutured lacerated wounds can lead to permanent scarring over lids and face. Corneal injuries can lead to development of corneal opacities, depending upon the depth of involvement of cornea and subsequent astigmatism, leading to decrease in vision. Other major causes of decrease in vision include traumatic mydriasis, traumatic cataract, vitreous abnormalities, macular edema and retinal detachment. Damage to angle structures can lead to development of angle recession glaucoma. Management of all these, require prolonged hospital visits and treatment expenses, leading to financial as well as mental constraint to the patient and family.

Conclusion

Ocular injuries from fire crackers are very common, specially among the children. Most of the patients had improvement of vision with time but severe injuries can lead to permanent loss of vision or decreased vision from squealae of wound healing such as astigmatism. The final visual acuity depends upon the severity of injury. Hence, stricter implementation of existing laws and regulations, public education and awareness is needed to prevent avoidable blindness resulting from use of fire crackers.

Limitations

We included only those patients who presented to our hospital around Diwali festival which may have resulted in underestimation of the actual problem.

Conflicts of Interest

None

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References

1. Hatamabadi HR, Tabatabaey A, Heidari K, Karim MK. Firecracker injuries during Chaharshanbeh Soori festival in Iran: A case series study. Arch Trauma Res 2013;2:46-9.
2. Bagri N, Saha A, Chandelia S, Dubey NK, Bhatt A, Rai A *et al*. Fireworks injuries in children: A prospective study during the festival of lights. Emerg Med Australas 2013;25:452-6.
3. Witsaman RJ, Comstock RD, Smith GA. Pediatric fireworks-related injuries in the United States: 1990–2003. Pediatrics 2006;118:296-303.
4. Dhir SP, Shishko MN, Krewi A, Mabruka S. Ocular fireworks injuries in children. J Pediatr Ophthalmol Strabismus 1991;28:354-5.
5. Mohan K, Dhir SP, Munjal VP, Jain IS. Ocular fireworks injuries in children. Afr Asian J Ophthalmol 1984;2:162-5.
6. Gilbert C, Foster A. A childhood blindness in the context of vision 2020-The right to sight. Bull World Health Organ.2001;79;227-32.
7. Arya SK, Malhotra S, Dhir SP, Sood S. Ocular fireworks injuries clinical features and visual outcomes. Indian J Ophthalmol. 2001;49:189-90.
8. Tandon R, Agarwal K, Narayan RP, Tiwari VK, Prakash V, et al. firecracker injuries during Diwali festival: the epidemiology and impact of legislation in Delhi. Indian J Plast Surg. 2012;45:97-101.
9. Chakraborti C, Majumdar S, Gayen S. Profile of firecracker injuries of the eye during Diwali: A tertiary eye-care center study. Med J DY Patil Vidyapeeth 2019;12:415-8.
10. Gupta H, Gupta P, Tyagi R, Gupta M. Analysis of ocular trauma due to firecracker injury in oculoplasty clinic at a tertiary care hospital in North India. Int J Oncol Oculoplasty. 2019;5(4):251-5.
11. Adenuga OO, Kannan NB, Ahuja AA, Ramasamy K. Ocular trauma from fireworks during diwali festival. Niger J Ophthalmol. 2018;26:51-5.
12. Kuhn FC, Morris RC, Witherspoon DC, Mann L, Mester V, Módis L *et al.* Serious fireworks-related eye injuries. Ophthalmic Epidemiol 2000;7:139-48.
13. Singh DV, Sharma YR, Azad RV. Visual outcome after fireworks injuries. J Trauma 2005;59:109-11.
14. Jing Y, Yi-Qiao X, Yan-Ning Y, Ming A, An-Huai Y, Lian-Hong Z. Clinical analysis of firework-related ocular injuries during Spring Festival 2009. Graefes Arch Clin Exp Ophthalmol 2010;248:333-8.
15. Malik A, Bhala S, Arya SK, Sood S, Narang S. Five-year study of ocular injuries due to fireworks in India. Int Ophthalmol 2013;33:381–5.
16. John D, Philip SS, Mittal R, John SS, Paul P. Spectrum of ocular firework injuries in children: A 5-year retrospective study during a festive season in Southern India. Indian J Ophthalmol 2015;63:843-6.
17. Kumar R, Puttanna M, Sriprakash K S, Sujatha Rathod B L, Prabhakaran VC. Firecracker eye injuries during Deepavali festival: A case series. Indian J Ophthalmol. 2010;58:157-9.

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