Original Article

Firework-related Ocular Injuries During Festival Season: A Hospital-based Study in a Tertiary Eye Care Center of Nepal

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Abstract

Introduction: Firework-related ocular injuries are an important cause of preventable ocular injuries and are common during the festival season. Despite the strict legislation in Nepal, the use of a firework is still commonly used during Tihar and Chaath festivals.
Objective: To evaluate the demographic distribution, mode of injuries, causative firework, clinical presentations and its management among the fire work- related injuries.
Methods: Hospital-based, single-center, cross sectional observational study.
Results: A total of 57 patients (65 injured eye) were included in the study. The left eye was involved in 49.1%, and male were more commonly involved (82.5%). Children less than 16 years were predominantly involved (77.2%). Mean age of the patients was 15.3±14.7 years. 36 (63.2%) injured were actively involved individuals. Firecrackers 32 (56.1%) were the most common type of fireworks causing injury. The closed globe injuries were more common 78.5%, most commonly with corneal abrasion 21 (32.3%). Following management, visual improvement was seen in all eyes except in 3 eyes (4.6%) who had visual acuity of NPL (no perception of light) at the time of presentation.
Conclusion: Public awareness about the possible devastating effects of fireworks, preventive measures and early intervention are essential. Strict legislation should be implemented to regulate manufacture, sale and use of fireworks to reduce the blindness due to this preventable cause.

Key words: festival, firework, firecracker injuries, ocular injuries

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Introduction

Firework-related ocular injuries are common during the festival season. Tihar -a five-day-long festival of light is followed by Chhath puja which is widely celebrated in the southern belt of Nepal and to some lesser extent in other parts of the country.

The use of fireworks is legally prohibited in Nepal. Various awareness programs are run during the festival season to discourage the use of fireworks. Despite these efforts, it is used during festivals solely for the entertainment purposes

Ocular trauma is the second leading cause of unilateral blindness in Nepal (13.6%), after cataract (34.2%) (Brilliant et al, 1985). In children, corneal opacity (39%) is the most common cause of unilateral blindness (Adhikari et al, 2015). It has been reported that the use of firework during festival has affected 85,800 children (1990-2003) in USA (Witsaman et al, 2006), 7 per 100,000 children (annually) in Greece (Vassilia et al, 2004), 4447 patients during two days of New Year (over 12-year period) in Denmark (Foged et al, 2007), and, 1 per 100,000 in India (Tandon et al, 2012). In China, a high rate of firework-related ocular trauma occurred in months adjacent to the Chinese New Year festival (Wang et al, 2017). Thus, firework ocular injuries during festival season are a global problem. In the USA, states restricting firework had a reduction in the incidence of firework trauma by seven times (Berger et al,1985). Similarly, reduction of ocular injuries was observed in Finland where sale of fireworks to below 18 years of age was restricted, allowed use of gunpowder from 200g to 75g was reduced and use of roman candles and bottle rocket which accounted for the most common cause of ocular injuries were banned (de Faber et al,2020). Also, in the Netherlands, severe ocular injuries have increased due to an increase in amounts of explosive material in fireworks (de Faber et al, 2020).

Firework-related injuries are known to cause mild to severe ocular injuries, at times with irreversible loss of vision (Sandvall et al, 2017). This cross-sectional observational study was planned to evaluate the demographic distribution, mode of injuries, causative firework, clinical presentations and visual among the firework- related injuries seen during the festival seasons.

Materials and methods

This was a hospital-based, single-center, cross sectional observational study. All the patients with firework-related injuries who attended the emergency and outpatient department of Sagarmatha Chaudhary Eye Hospital (SCEH), Lahan, a tertiary eye care center in eastern Nepal during or within 1 month (2 weeks prior and after the festival session) of the festival season (Tihar and Chaath puja) in two consecutive years were included in this study. All patients underwent a detailed ocular examination. Visual Acuity at presentation was recorded, Anterior segment examination was done by torch light and slit lamp biomicroscopy. Eyelid versions were done to search for foreign bodies. Fluorescein staining was done to evaluate conjunctival or corneal defects. Posterior segment examination was done by direct and indirect ophthalmoscopy. Intraocular pressure (IOP) measurement was done with an applanation tonometer. USG (A+B) Scan was carried out to assess posterior segments to rule out retained intraocular foreign body (IOFB) in patients with hazy media. X-Ray of the orbit was done to rule out retained IOFB. Patients were treated on an outpatient department (OPD) basis or admitted for observation and further management according to the severity of the cases.

Visual acuity was noted at the time of presentation and at the time of discharge (Day 5) for admitted patients, and at the first follow up visit (Day 5) for the patient treated on an outpatient basis. The demographic data, all

clinical findings, investigations, and treatment provided were collected with the help of pre-tested proforma in two consecutive years (2018 and 2019). Data entry was done in Microsoft excel sheet. Absolute frequency (n) and relative frequency (%) were used to analyze qualitative variables, and mean and standard deviation (mean ± SD) were used to analyze quantitative variables

In our study, we define various commonly used firework items according to the size, shape, and mode of use into firecrackers, bombs, rockets, pot flowers or sparklers. "Firecrackers" are defined as fireworks items that are usually available as cylindrical red items, and come in a packet of around 15-20 that contains flash powder, wrapped in the paper with a fuse attached, which when lit bursts with a loud noise. "Bombs" are defined as round shaped firework items that burst with a loud noise when the fuse attached to it is lit. "Rockets" are defined as firework items with a stick attached to it which propels itself into the air. "Pot flowers" are defined as a firework that remains in the ground and emits showers or sparkles several feet in the air when lit. "Sparklers" are defined as firework items with a non- combustible metallic wire, 8-12 inches long, which on ignition produces sparks and coloured flames. All the ocular injuries were classified according to Birmingham Eye Trauma Terminology System (BETTS)

Results

A total of 57 patients (65 injured eyes) were included in the study. The right eye was involved in 21 (36.8%), left eye 28 (49.1%) and bilateral involvement was seen in 8 patients (14.0%). Male were more commonly involved (82.5%) than females (17.5%). Twenty-seven patients (47.4%) were from Nepal, and the rest from India (52.6%). Children less than 16 years were predominantly involved (77.2%) than adults or old age groups. Mean age of the patients was 15.3±14.7 years (range 5yr – 75 yr). Bystanders were affected in 21 (36.8%) cases while 36 (63.2%) of the cases with injuries seen were actively involved individually. Firecrackers 32 (56.1%) were the most common type of fireworks causing injury, followed by bombs, rockets, sparklers 7 each (12.3%) and pot flower 4 cases (7.0%) (Table 1).

Following injuries, 14% presented in our center within less than 1 hour, 21.1% presented within 1-6 hour, 15.8% presented within 12 hour, 10.5% more than 12 hour to 24 hour, 14.0% presented more than 24 hour to 48 hour and 22.8% presented more than 48 hour. 78.9% had received first aid management (Table 2).

The closed globe injuries were more common 78.5% compared to open globe injuries 21.5%. The closed globe injuries presented most commonly with corneal abrasion 21 (32.3%), followed by hyphema 19 (29.2%), burn to eyelids and face 18 (27.7%), traumatic cataract 6 (9.2%) , lid laceration 5 (7.7%), iridodialysis 4 (6.15%) and traumatic uveitis 2 (3.08%). The presentations among open globe injuries were most commonly corneal perforation 12 (18.5%) followed by limbal perforation with Iris prolapse 8 (12.3%) and badly traumatized eye 3 (4.6%). The clinical characteristics are shown in Table 3.

Management: Out of total 57 patients, 29 (50.9%) were managed by admission in hospital and the rest were treated on OPD basis. Surgical management was needed in all 29 admitted patients. Hyphema wash was done in 12 (18.5%), corneal repair in 12 (18.5%), iris reposition and limbal repair in 8 (12.3%), lens extraction with post chamber intraocular lens implantation (IOL) in 4 (6.1%), lens extraction with no IOL in 1 (1.5%) and evisceration was done in 3 eyes (4.6%) (Table 4). Conservative management on OPD basis was done in 28 (49.1%) patients. Standard treatment protocol for ocular burns and chemical injuries were followed.

Visual Acuity

The vision of all 65 eyes were noted at the time of presentation and at the time of discharge or first follow-up visit on day 5. According to the initial assessment of vision at the time of presentation, 41 eyes (63.1%) had visual acuity worse than 6/18. Following management, visual acuity of most patients improved and visual acuity worse than 6/18 was seen in only 24 eyes (36.9%)

Out of total 65 eyes, visual acuity less than 3/60 to PL (perception of light) was seen in 29 eyes (44.6%) at the time of presentation, while following management visual acuity less than 3/60 to PL was present in only 8 patients (12.3%). Visual improvement was seen in all eyes except in 3 eyes (4.6%) who had visual acuity of NPL (no perception of light) at the time of presentation (Table 5).

Some of the clinical presentations are shown in Figure 1.

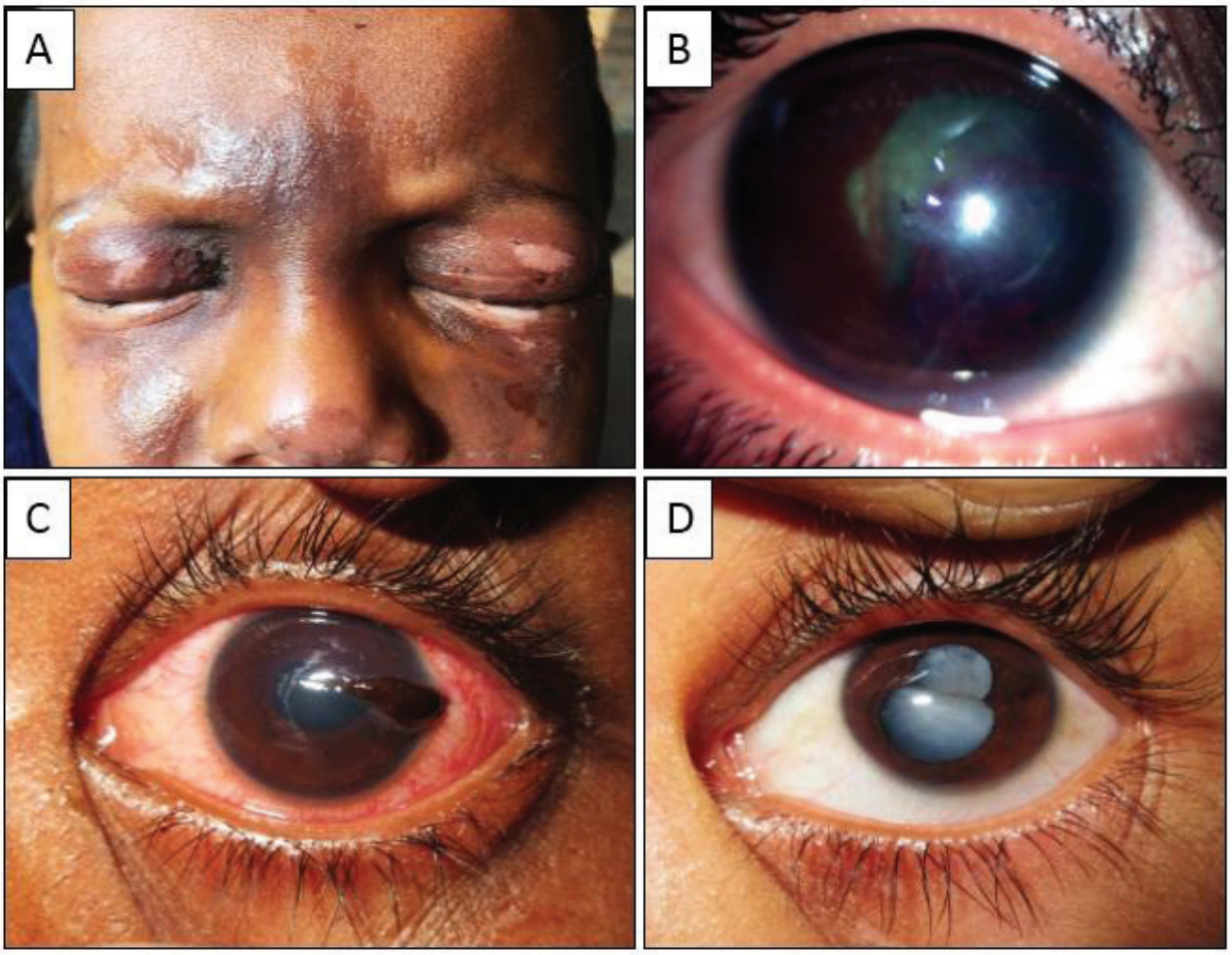

Figure 1: [A] Superficial burn with periocular involvement, [B] Hyphema, [C] Corneal perforation with iris prolapse, [D] Traumatic cataract

Table 1: Demographic characteristic of all patients

Characteristic		**2018**	**2019**	**Total**
Total no. of patients (n)		28	29	57
		31	34	65
Total no. of eyes	Right	13	8	21
	Left	12	16	28
	Bilateral	3	5	8
Gender	Male	24	23	47
	Female	4	6	10
Nationality	Nepal	14	13	27
	India	14	16	30
Age (years)	<16	23	21	44
	16-65	5	7	12
	>65	0	1	1
Circumstance	Active	15	21	36
	Bystanders	13	8	21
Type of firework	Firecrackers	15	17	32
	Bombs	5	2	7
	Rockets	5	2	7
	Sparklers	2	5	7
	Pot flower	1	3	4

Table 2:

Time of Presentation	**2018 (n=28)**	**2019 (n=29)**	**Total n=57**
< 1 hour	1 (3.6%)	7 (24.1%)	8 (14.0%)
1 – 6 hour	8 (28.6%)	4 (13.8%)	12 (21.1%)
>6 hour-12 hour	6 (21.9%)	3 (10.3%)	9 (15.8%)
>12 hour -24 hour	1 (3.6%)	5 (17.2%)	6 (10.5%)
>24hr-48 hour	4 (14.3%)	4 (13.8%)	8 (14.0%)
>48 hour	8 (28.6%)	5 (17.2%)	13 (22.8%)
First Aid Management			
YES	21(75%)	24 (82.8%)	45 (78.9%)
NO	7(25%)	5 (17.2%)	12 (21.1%)

Table 3: Clinical characteristics of all patients

Clinical characteristics	2018 (n=31)	2019 (n=34)	Total (n=65)
Type of injury			
Closed globe injuries	25 (80.6%)	26 (76.5%)	51 (78.5%)
Open globe injuries	6 (19.3%)	8 (23.5%)	14 (21.5%)
Closed globe injuries			
Corneal abrasion	8 (25.8%)	13 (38.2%)	21 (32.3%)
Hyphema	9 (29.0%)	10 (32.2%)	19 (29.2%)
Burn to eyelid and face	10 (32.2%)	8 (23.5%)	18 (27.7%)
Traumatic Cataract	2 (6.4%)	4 (11.8%)	6 (9.2%)
Lid laceration	2 (6.4%)	3 (8.8%)	5 (7.7%)
Iridodialysis	3 (9.7%)	1 (2.9%)	4 (6.15%)
Traumatic uveitis	1 (3.2%)	1 (2.9%)	2 (3.08%)
Open globe injuries			
Corneal perforation	6 (19.3%)	6 (17.6%)	12 (18.5%)
Limbal perforation with Iris prolapse	6 (19.3%)	2 (5.9%)	8 (12.3%)
Badly traumatized eye	1 (3.2%)	2 (5.9%)	3 (4.6%)

Table 4: Type of management

	Year 2018 (n = 31)		Year 2019 (n = 31)		Total (n = 65)	
Treatment modalities	**n**	**%**	**n**	**%**	**n**	**%**
Medical management	15	48.4	21	61.8	36	55.4
Surgical Management	16	51.6	13	38.2	29	44.6
Type of Surgical intervention						
Hyphema wash	6	19.4	7	20.6	13	20.0
Corneal repair	6	19.4	6	17.6	12	18.5
Iris reposition + limbal repair	6	19.4	2	5.9	8	12.3
Lens extraction + PCIOL implantation	2	6.5	2	5.9	4	6.1
Evisceration	1	3.2	2	5.9	3	4.61
Lens extraction + No IOL	0	0	1	2.9	1	1.5
PCIOL: post chamber intraocular lens; IOL: Intraocular lens						

Table 5: Visual Acuity

Visual Acuity (n= 65 eye)	At presentation (UCVA)	At Day 5 (UCVA)
6/6-6/18	24 (36.9%	41 (63.1%)
6/25-6/60	9 (13.8%)	13 (20%)
3/60-1/60	9 (13.8%)	6 (9.2%)
Hand Movement	13 (20%)	2 (3.1%)
Perception of Light (PL)	7 (10.8%)	X
No perception of light (NPL)	3 (4.6%)	3 (4.6%)
UCVA: Uncorrected visual acuity		

Discussion

There is a high incidence of partial or complete permanent vision loss in globe-injured patients (Sandvall et al, 2017). Despite multiple and prolonged treatment, partial or complete permanent vision loss may occur (Frimmel et al, 2018) in patients with firework injuries. Our study was a hospital-based, single-center, cross sectional observational study involving firework related injuries during the festival season (Tihar and Chaath puja). The majority were male 47 (82.5 %), similar to previous studies (Frimmel et al, 2018; Venkatesh et al, 2017; Wisse et al, 2010). Forty four (77.2%) patients were less than 16 years of age. Male children are more commonly involved in outdoor activities and recreations than the females in our society leading to devastating effects and lifelong trauma (physical or psychological) (Wisse et al, 2010).

Although the majority of the injured were actively involved in launching 63.2%, the involvement of 36.8% bystanders were alarming, which shows it is equally dangerous to be in the premise where fire-work is being launched. Previous studies have also shown innocent bystanders to be involved in 14-61% (Frimmel et al, 2018; Venkatesh et al, 2017; Wisse et al, 2010). Majority of ocular injuries were caused by Firecrackers 56.1% followed by bombs, rockets and sparklers 12.3% each, which is similar to previous studies (Venkatesh et al, 2017). In our study, closed globe injuries 78.5% presented with corneal abrasion 32.3%, hyphema 29.2% and burn to eyelid and face 27.7%, were found to predominant which is similar to the previous studies (Venkatesh et al, 2017; Arya et al, 2001). Following treatment 24 (36.9%) had visual acuity worse than 6/18 as compared to 41(63.1%) at the time of presentation. Ocular injuries range from mild eyelid burn to devastating injuring leading to evisceration. This not only affects the patient but also the family members and society. The psychological trauma, financial and social burden outweighs the use of fireworks as entertainment.

In our study, 78.9% received first aid management. Prompt referral to and treatment by ophthalmologists is critical. Public awareness regarding safety precautions can reduce the number and severity of firework- related injuries (Nizamoglu et al, 2018). It is essential to add chapters focusing on the hazards of use of fireworks in festivals in existing coursebooks for school-going children. Banning advertisement promoting fireworks, compulsory printing pictures of traumatized eyes to raise awareness similarly as done by cigarette manufactures and repeatedly broadcasting through different media, involvement of celebrities for public awareness, talk programs, and school visits, sharing through social network, awareness text through mobiles are some of the methods

which can be adapted to increase the level of awareness (Kumar et al, 2010). Apart from the various awareness programs, strict enforcement of the existing laws should be implemented.

The limitations of our study are small sample size and short follow up.

Conclusion

Fireworks related ocular injuries range from mild eyelid burns to devastating effects like vision loss and even loss of eyes. Blindness from ocular trauma due to fireworks are however preventable. Public awareness about the possible devastating effects of fireworks, preventive measures and early intervention are essential. Strict legislation should be implemented to regulate manufacture, sale and use of fireworks to reduce the blindness due to this preventable cause.

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References

Adhikari S, Shrestha MK, Adhikari K, Maharjan N, Shrestha UD (2015). Causes of visual impairment and blindness in children in three ecological regions of Nepal: Nepal Pediatric Ocular Diseases Study. CLIN Ophthalmol; 9:1543–1547. DOI: 10.2147/OPTH.S89431

Arya SK, Malhotra S, Dhir SP, Sood S (2001). Ocular fireworks injuries. Clinical features and visual outcome. Indian J Ophthalmol; 49(3):189-90.

Berger LR, Kalishman S, Rivara FP (1985). Injuries from fireworks. Pediatrics;75(5):877-82.

Brilliant LB, Pokhrel RP, Grasset NC et al (1985) Epidemiology of blindness in Nepal. Bull World Health Organ;63(2):375-386.

de Faber JT, Kivelä TT, Gabel-Pfisterer A (2020). National studies from the Netherlands and Finland and the impact of regulations on incidences of fireworks-related eye injuries. Ophthalmologe;117(Suppl 1):36-42. DOI: 10.1007/s00347-019-00996-4.

Foged T, Lauritsen J, Ipsen T (2007). Firework injuries in Denmark in the period 1995/1996 to 2006/2007. Ugeskr Laeger;169(49):4271-5.

Frimmel S, de Faber JT, Wubbels RJ, Kniestedt C, Paridaens D (2018). Type, severity, management and outcome of ocular and adnexal firework-related injuries: the Rotterdam experience. Acta Ophthalmol;96(6):607-615. DOI: 10.1111/aos.13711.

Kumar R, Puttanna M, Sriprakash KS, Sujatha Rathod BL, Prabhakaran VC (2010). Firecracker eye injuries during Deepavali festival: A case series. Indian J Ophthalmol; 58(2): 157–159. DOI: 10.4103/0301-4738.60095.

Nizamoglu M, Frew Q, Tan A, Band H, Band B, Barnes D, El-Muttardi N, Dziewulski P (2010). The ten-year experience of firework injuries treated at a uk regional burns & plastic surgery unit. Ann Burns Fire Disasters;31(1):13-16.

Sandvall BK, Jacobson L, Miller EA, Dodge RE , Alex Quistberg D, Rowhani-Rahbar A, Vavilala MS, Friedrich JB, Keys KA (2017). Fireworks type, injury pattern, and permanent impairment following severe fireworks-related injuries. Am J Emerg Med;35(10):1469-1473. DOI: 10.1016/j.ajem.2017.04.053.

Tandon R, Agrawal K, Narayan RP, Tiwari VK, Prakash V, Kumar S, Sharma S (2012). Firecracker injuries during Diwali festival: The epidemiology and impact of legislation in Delhi. Indian J Plast Surg;45(1): 97-101.DOI: 10.4103/0970-0358.96595

Vassilia K, Eleni P, Dimitrios T (2004). Firework-related childhood injuries in Greece: a national problem. Burns;30(2):151-3. DOI: 10.1016/j.burns.2003.09.019

Venkatesh R, Gurav P, Tibrewal S, Agarwal M, Dubey S, Mathur U, Ganesh S, Das S (2017). Appraising the spectrum of firework trauma and the related laws during Diwali in North India. Indian J Ophthalmol;65(2):140-143. DOI: 10.4103/ijo.IJO_527_16.

Wang W, Zhou Y, Zeng J, Shi M, Chen B (2017). Epidemiology and clinical characteristics of patients hospitalized for ocular trauma in South-Central China. Acta Ophthalmol;95(6): e503-e510. DOI: 10.1111/aos.13438.

Wisse RP, Bijlsma WR, Stilma JS (2010). Ocular firework trauma: a systematic review on incidence, severity, outcome and prevention. Br J Ophthalmol;94(12): 1586-91.DOI: 10.1136/bjo.2009.168419.

Witsaman RJ, Comstock RD, Smith GA (2006). Pediatric fireworks-related injuries in the United States: 1990-2003. Pediatrics;118(1):296-303. DOI: 10.1542/peds.2006-0790.