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Original Article

Epidemiological pattern of corneal foreign bodies and utilization of protective eye devices: a hospital-based cross-sectional study

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ABSTRACT

Introduction: A corneal foreign body (CFB) is the most common occupational ocular injury that can cause secondary infection or scars on the visual axis, decreasing vision. This study aimed to find-out practices of wearing protective eye devices in the workplace and the factors influencing the utilization of such devices among patients with CFB injury.

Methods: A cross-sectional study was conducted in a tertiary eye hospital in Bhaktapur from April to August 2021. All patients with CFB attending the hospital were included in the study. CFB was removed with ocular examination under a slit lamp biomicroscope, and a face-to-face interview was conducted.

Results: Among 142 patients, only one was female, and 41.5% had a previous history of CFB. The most common CFB particle was metallic (n=124, 87.3%). Three-fourths (75.1%) of patients were not using eye-protective devices at the time of injury, and 45.1% tried physically removing the CFB in a harmful way. Nearly one-fifth (19.7%) had used topical antibiotic eye drops before presenting for CFB removal. Nearly half of the participants (46.5%) reported never wearing any protective eye devices, and the main reason for it was the unavailability of such devices at their workplace. The awareness of the need for protective eye devices ($p<0.001$) was significantly associated with using protective eye devices during work.

Conclusion: The workers should be made aware of the consequences of harmful practices following CFB injury. The workers should wear protective eye devices to minimize the risk of ocular injury and consequent visual impairment.

Keywords: Cornea, Foreign Body, Protective Device, Workplace.

Introduction

Ocular injuries are a major cause of preventable blindness worldwide.[1] Work-related eye injuries constitute a public health problem responsible for significant morbidity, disability, and socioeconomic damage.[2,3] A corneal foreign body is the most common occupational ocular injury, which occurs across several occupations like metallic and construction workers, electricians, carpenters, etc.[4,5]

It causes multiple ocular symptoms, including red-eye, foreign body sensation, pain, blurred vision, etc.[6] It can also cause secondary infection or scars on the visual axis, decreasing vision.[7] These injuries account for a significant amount of time taken off work for hospital visits, increasing healthcare costs.[8]

The Bhaktapur Eye Study showed that the prevalence of ocular injuries in Nepal is 3.7%,[9] and the incidence varies from 2.2% to 4.9% each year, according to one study in Western Nepal.[10] The corneal foreign body comprises 20.4% to 22.5%

of ocular injuries cases in Nepal.[11, 12]

Industrialization and urbanization have increased eye injuries worldwide, and similar is the situation in Nepal with an increase in the number of patients with OPD with corneal foreign body (CFB) injuries.[13,14] The proper use of protective equipment would prevent 60–66% of eye injuries at the workplace.[13] However, lack of use of protective equipment, poor health-seeking behavior of patients due to lack of education, or negligence create a worse prognosis, especially in developing countries.[14] Hence this study was conducted to determine the etiologic factors, level of awareness, and utilization of eye protective equipment among the workers presenting with a CFB.

Methods

A cross-sectional study was conducted in the Hospital for Children, Eye, ENT, and Rehabilitation Services (CHEERS), Bhaktapur, Nepal. All the consecutive patients aged 18 years and above presenting with a complaint of foreign body in the Eye Outpatient Department of the Hospital from April to August 2021 were included in the study.

Each patient underwent a careful, comprehensive slit lamp bio-microscopic examination by the attending Ophthalmologist to find the location, type of foreign body, complications, and corneal scars to determine past injuries and was recorded in OPD Cards. Corneal foreign bodies were removed using a 26-gauge needle under topical anesthesia, and topical antibiotics were prescribed for a week.

Each patient was offered to participate in the study by an accompanying Ophthalmic Assistant who was oriented about the study and trained for data collection. The patients and their companions were briefed about the study objective, the information needed, and the expected duration of the interview. Only those patients or companions (for illiterate patients) who gave written consent to participate were selected for the study and interviewed for data collection using a semi-structured questionnaire. At the same time, the location, type, complications, and previous history of the foreign body were recorded from OPD Cards. The patients who had CFB at places other than workplace settings were excluded from the study. The corneal foreign body was marked as central, paracentral, and peripheral, taking into account a 3 mm radius as central, 3 to 6 mm radius as paracentral, and beyond that as peripheral.[15]

The study team developed the study tool from literature review and finalized it after inputs from the expert advice of fellow Ophthalmologists, Public Health, and Health Promotion experts. The tool in the Nepali language was pre-tested in City Eye Clinic, Thimi, Bhaktapur, among 10 patients with CFB and modified for the structure and tone of the questions. Permission for the study was taken from the study site, CHEERS Hospital, and ethical approval was obtained from the Ethical Review Board of Nepal Health Research Council (Ref. No. 2778, ERB Protocol No. 109/2021P).

The interviewers entered all the data from the questionnaire in Google Sheets on the same day of data collection. The data entered were checked and cross-checked for completeness by the researchers every day. The analyses were done using IBM Statistical Package for the Social Sciences (SPSS) version 26.0 (Released 2019. IBM Corp., Armonk, New York, United States). The frequencies and percentages were computed to assess the distribution of population characteristics, including age group, educational status, occupational settings, awareness about protective eyewear, history of foreign bodies in the eye, etc. To identify the associations between explanatory variables and the use of protective eye devices, bivariate logistic regression analyses was applied. Those variables with p-values <0.05 were included in a multivariate logistic regression analysis to determine the effect adjusted for each potential explanatory variable. A p-value of <0.05 denoted statistical significance.

Results

Among 149 patients approached for the study, 142 (95.3%) participated and completed the interview session.

Socio-demographic characteristics of the patients

More than four-fifths (83.8%) of participants were aged 18-40 years old, and only one female participant was in the study. More than two-thirds (67.6%) worked in the metallic and grill industry, as shown in Table 1.

Table 1. Socio-demographic profile of the study participants (n=142)

Characteristics		Frequency	Percentage
Age-group	18 – 40 years	119	83.8
	41 – 70 years	23	16.2
Gender	Male	141	99.3
	Female	1	0.7
Permanent residence	Kathmandu valley	20	14.1
	Outside of Kathmandu valley	122	85.9
Education	Illiterate	28	19.7
	Literate	25	17.6
	Primary level	37	26.1
	Secondary level	35	24.6
	Intermediate	13	9.2
	Bachelor's and above	4	2.8
Type of Workplace	Metallic & grill	96	67.6
	Carpentry	11	7.8
	Building & constructions	30	21.1
	Others	5	3.5

Foreign body injury and complications

Two patients visited for consultation within half an hour of foreign body injury, whereas 4.9% consulted after more than one week of the injury. The mean time before presenting for consultation was 44.52 (±46.97) hours. The average working days lost due to foreign body injury was 1.17 (±1.16).

More than half (53.5%) had a foreign body in their right eye, and 87.3% of study participants had a metallic foreign body. None had open globe injury, and the most common location of the foreign body was the paracentral (57.7%). More than one-fourth (26.1%) of the study participants had already developed complications following injury, and keratitis was the most common (62.2%), as shown in Table 2. Less than one-fourth (24.6%) of study participants reported wearing or using eyewear during the injury, and 24 of them were wearing goggles or sunglasses.

History of foreign body injury

More than two-fifths (41.5%) reported a history of previous foreign body injury in at least one of their eyes. On slit-lamp examination, 26.1% had scars in at least one eye suggestive of the previous history. Nearly two-fifths of (38.7%) study participants' colleagues also had similar foreign body injuries in the past.

Practices following foreign body injury

More than two-fifths (45.1%) of the study participants physically tried to remove the foreign body either by self (n=45) or with the help of friends, colleagues, or family members (n=16) or with the help of non-eye health workers (n=2). Among those who tried to remove the foreign body, the most used material was handkerchiefs and other clothes (n=41). More than three-fifths (62.0%) of participants reported trying several remedies, like washing their eyes with clean water and using human milk, as shown in Table 3.

Table 2. Foreign body injury among participants (n=142)

Characteristics		Frequency	Percentage
Injured Eye	Right	76	53.5
	Left	66	46.5
Location of Foreign Body	Central	29	20.4
	Paracentral	82	57.7
	Peripheral	31	21.8
Type of Foreign body	Metallic particles	124	87.3
	Wooden particles	4	2.8
	Sand & stone particles	10	7.1
	Others (plastics & carbon particles)	4	2.8
Complications following injury	None	105	73.9
	Keratitis	23	16.2
	Epithelial defect	9	6.4
	Corneal ulcer	4	2.8
	Iritis	1	0.7
Use of any protective eyewear during injury	None	107	75.4
	Goggles or sunglasses	24	16.9
	Glasses or spectacles	4	2.8
	Protective eye wears	6	4.2
	Metallic shield	1	0.7

Less than half (47.9%) of the participants directly reported to our eye hospital. Among the remaining 74 participants, 85.1% visited the nearby local pharmacy, 6.8% visited local clinics, 5.4% visited local eye clinics, and 2.7% reported visiting a general hospital (with no eye care services) to seek treatment before presenting to our eye hospital with an injury. Nearly three-fifths (59.9%) of participants reported using eyedrops before presenting to our eye hospital with a foreign body injury. Among them, one participant reported using topical steroids, none reported using eye ointment, and we could not verify the 29 medicines as depicted in table 3.

Awareness and practices on Occupational Eye Health

Two-fifths (40.8%) of participants had not received formal health and safety education on occupational eye health. However, more than two-thirds (72.5%) knew that a foreign body could cause visual impairment. But nearly one-third (32.4%) of participants were unaware of the need for protective eyewear at their workplace.

Practices of using protective eye devices at the workplace (n=142)

More than two-fifths (46.5%) of participants reported never using protective eye devices primarily due to the unavailability of such devices at their workplace, as presented in table 4.

Factors influencing use of protective eye devices

The bivariate analysis showed that literacy status (p=0.016), health education on occupational eye hazards (p=0.004), awareness about visual impairment from foreign body injury (p=0.044), history of the previous injury among self or colleagues (p=0.006), and awareness of the need of protective eye devices (p<0.001) were significantly associated with the use of protective eye devices during work. However, the multivariate logistic regression model suggested that the awareness of the need for protective eye devices (p=0.005, OR=18.883, 95% CI: 2.432-146.636) was the only variable significantly associated with the use of protective eye devices, as depicted in table 5.

Table 3. Practices following foreign body injury (n=142)

Characteristics		Frequency	Percentage
Physically tried	No	78	54.9
Removing	Using handkerchiefs and other clothes	41	28.9
	Using coins	9	6.4
	Using paper note	7	4.9
	Using nails or needles	2	1.4
	Others (threads, pieces of cotton)	3	2.1
	Irrigation and syringes (at health center)	2	1.4
Self-	None	54	38.0
Remedy tried	Cleaning with cold water	67	47.2
before	Use of old eye drops	15	10.6
visiting Eye	Use of unprocessed herbal products	3	2.1
Hospital or other health	Use of human milk	2	1.4
Facilities	Cleaning with lukewarm water	1	0.7
Eye	None	57	40.1
medicines used	Topical antibiotics eye drops	28	19.7
before	Lubricating eye drops	19	13.4
presenting to Eye	Naphazoline+ Phenylephrine	8	5.7
Hospital	Topical steroids eye drops	1	0.7
	Don't know	29	20.4
	Eye ointment	0	0.0

Table 4: Practices of using protective eye devices at workplace

Characteristics		Frequency	Percentage
Practices of	Never	66	46.5
using	Goggles or Sunglasses	55	38.7
Protective Eye Wear at	Special protective eyewear	10	7.1
Workplace (n=142)	Simple glasses	9	6.3
	Metallic shield	2	1.4
Reason for not wearing	Not available	32	48.4
protective eye gear (n=66)	Felt unnecessary	15	22.8
	Uncomfortable	15	22.8
	Poor visibility	3	4.5
	Damaged or lost wear	1	1.5

Table 5: Association between patient's characteristics and use of protective eye devices

Characteristics		Wearing Protective Eye Devices		p-value	COR (95% CI)	p-value	AOR (95% CI)
		Yes n (%)	No n (%)				
Age-Group	41 years and above	6 (26.1)	17 (73.9)	0.861	1.095 (0.395 – 3.039)	NA	NA
	18 – 40 years	29 (24.4)	90 (75.6)				
Literacy status	Literate or with formal education	33 (28.9)	81 (71.1)	0.016*	5.296 (1.189 – 23.597)	0.101	3.757 (0.773 - 18273)
	Illiterate	2 (7.1)	26 (92.9)				
Ever received health education on occupational eye health hazards	Yes	28 (33.3)	56 (66.7)	0.004*	3.643 (1.465 – 9.059)	0.118	2.350 (0.804 – 6.866)
	No	7 (12.1)	51 (87.9)				
Awareness about Foreign Body can cause Visual Impairment	Yes	30 (29.1)	73 (70.9)	0.044*	2.795 (0.997 – 7.832)	0.444	1.519 (0.444 – 5.192)
	No	5 (12.8)	34 (87.2)				
History of similar injury in past year with self or colleague	Yes	27 (33.3)	54 (66.7)	0.006*	3.313 (1.380 – 7.948)	0.072	2.418 (0.923 – 6.333)
	No	8 (13.1)	53 (86.9)				
Awareness on need of Protective Eye devices	Yes	34 (35.4)	62 (64.6)	<0.001*	24.667 (3.256 – 187.012)	0.005*	18.883 (2.432 – 146.636)
	No	1 (2.2)	45 (97.8)				

*: Statistically significant at p<0.05; CI: Confidence Interval, COR: Crude Odds Ratio, AOR: Adjusted Odds Ratio

Discussion

In this study, CFBs occurred predominantly in-migrant male workers, especially those working in the metallic and grill industries. The metallic foreign particles were the most common CFB.

Despite being aware of protective eye devices, the majority were not using them at the time of injury. Even after the injury, they indulged in unhealthy practices like self-medication or attempting to

remove the foreign body by themselves or friends. The awareness of the need for protective eye devices ($p<0.001$) was significantly associated with using protective eye devices during work.

In our study, most of the patients (83.8%) were in the age group 18 to 40 years. The mean age of the participants was 31.15 (±9.78) years, similar to the study done by Dass et al., where the mean age was 31 years, and most of the patients were below 40 years of age.[16] In this study, 99.3% of the patients were male, similar to the study by Agrawal et al., where 99% were male.[5] Male preponderance was also seen in several other studies.[15,17] This shows that young males are more prone to such injuries. This might be due to the predominance of young and inexperienced males in metallic and grill industries, carpentry, and other high-risk jobs without occupational safety awareness and practices.

About three-fourths (75.4%) of patients were not using protective eyewear at the time of injury. In a similar study in India, 86% of patients were not wearing glasses at the time of injury.[5] In a study by Tuladhar et al., only 6.6% gave a history of wearing protective devices while working.[11] In another study done in the United Kingdom, 39.33% of the patients with corneal foreign body injury were using some kind of eye protection while working.[18] The workers with awareness of the need for protective eye devices were about eighteen times more likely to use protective eye devices than those who were not in our study. Even though our study showed that 67.6% were aware of the need for protective eye devices, they were not wearing protective eye devices because of their unavailability (33.8%) at their workplace. The Labour Act of 2017 in Nepal clearly defines the employee's duty towards the workers in making workplaces safe by providing personal safety and provisions as required, which seems to be missing in Nepal in such small-scale industries or informal occupational settings.[19] Hence there should be regular supervision and monitoring from the concerned authorities regarding such provisions for laborers' health and safety.

Metallic and grill workers were most commonly affected (67.6%), followed by construction workers (21.1%) and carpenters (7.7%), and the most common foreign body material was metallic (87.3%) in our study. These findings resonated with the study done by Reddy et al., where industrial workers were most commonly affected, followed by the construction workers, and the metallic foreign body was the commonest,[8] as with the construction and metal industry workers in another study in Washington D.C.[20] In the older studies with ocular trauma, we could see that most corneal injuries were due to agricultural work and mainly occurred during harvesting seasons.[10] However, rapid urbanization and industrialization seem to have increased the shift in ocular injuries to mainly foreign bodies in Kathmandu valley.

The mean duration between injury and the first visit to an ophthalmologist was 44.52 (±46.97) hours which was almost similar to the other study conducted in Turkey, where the mean duration between the injury and the presentation for consultation was 2.16 (±0.26) days.[21] In our study, the most common location of CFB was the paracentral (57.7%) which was similar to other studies.[8, 15] Due to this, the central vision was not affected in most cases, which might be the reason for the late presentation at the hospital. Even though 72.5% replied that they were aware of CFB causing visual impairment, they were late in presenting to visit Ophthalmologists. This indicates that they were not well aware or have not internalized the consequences (severity) of CFB, which might be due to fewer workers in such workforces with higher education, as shown in our study, where only 36.6% had completed secondary education or above. Besides, our study showed that 41.5% had reported a history of previous corneal foreign bodies, and 26.1% had corneal scars suggesting past foreign body injury on slit-lamp examinations, implying that the participants had not internalized the consequences of CFB. Another reason for late presentation at the hospital could be the larger number (85.1%) of patients visiting local over-the-counter pharmacies after injury, and 59.9% used topical ocular medications. They might have waited for the medicine to have an effect on their

eye and only presented to us after the pain or discomfort did not subside. In addition, the time off from work to reach a nearby eye hospital in the first place could also have played a role in the late presentation to the eye hospital. In a study of ocular trauma in Nepal, 35% of patients had sought medical assistance before presenting to the hospital, and 41.9 % had been to pharmacies.[12] As the pharmacies are seen as the first point of contact, it is important to educate the health workers of such drugstores about the need for early contact at the eye center for CFB removal and appropriate eye drops.

We found that 41.5% of patients attempted CFB removal by themselves. In the study conducted by Ozkurt et al., 52% of patients attempted CFB removal on their own, which can cause further injury.[21] In this study, the most frequently used material was cloth or handkerchief (64%), followed by currency notes (10%). In contrast, the most commonly used materials for the removal were currency notes (31%), followed by napkins (7%) and cloth (4%) in a study done in Turkey.[21] Although our study showed that 59.2% reported receiving health education on occupational eye health hazards, unhealthy self-removal practices were still prevalent, leading to further complications and secondary infection. Hence, comprehensive eye health care education and training are advised, which is also the employer's role according to Nepal Labor Act 2017.[19]

Our study showed that the literacy status of the workforce was three to five times associated with the use of protective eye devices at the workplace. Similarly, a study done in South India among welders showed that workers with higher literacy levels had a higher protective eye device use.[22] Literacy is an important factor as literate workers are more likely to be aware of the visual impairment from CFB injury or their workplace safety rights.

Our study revealed that the workforce with a previous injury history among self or colleagues was two to three times more likely to use protective eye devices. The treating health workers mostly counsel about the consequences of CFB injury and the use of protective eye devices for patients with foreign body injury, which might have led to the use of protective eye devices in the future. Health promotion in hospital settings could educate the patients and reduce the incidence of visual impairment by encouraging workers to use protective eye devices in workplaces with a higher risk of ocular injuries. In a study, behavioral change was noted among the workers after an injury, and 66% of the workers were using eye protection since they had been treated for work-related eye injuries.[23]

Limitation of the study

The study was limited to the urban setting and only accommodated the patients coming to a tertiary level eye hospital. Hence this study cannot be generalized. Besides, this study only included patients coming for OPD checkups and did not include emergency care settings.

Conclusion

CFB occurs predominantly in young males working in the metallic and construction industries. Though most of the injuries are minor, it results in loss of days' work leading to economic loss. Even though relatively cost-effective protective measures exist, the lack of compliance limits their effectiveness and results in corneal foreign bodies. Besides, workers should be educated about such eye injuries and encouraged to use eye-protective devices properly during their work through regular and comprehensive educational workshops in high-risk workplaces. Protective eye devices use should be strictly supervised and enforced at high-risk workplaces.

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