Journal of Clinical & Experimental Ophthalmology

Sharma et al., J Clin Exp Ophthalmol 2019, 10:3

Research Article Open Access

Incidence of Repeated Superficial Metallic Corneal Foreign Bodies, Awareness and Use of Eye Protection Devices in Sub-urban Bangalore (South-India)

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Received date: February 08, 2019; **Accepted date:** March 22, 2019; **Published date:** March 31, 2019

Abstract

Purpose: To determine the incidence of repeated episodes of superficial metallic corneal foreign body (CFB) among small-scale metal industry workers in Bangalore (South-India). We also aim to discuss level of awareness and reasons of less/ non-usage of eye-protection devices (EPD) and to emphasize on the easily available EPD designs.

Materials and methods: This was a prospective study which included one hundred and twenty-two consecutive patients who were treated for superficial CFB from 1st October 2017 to 31st March 2018 in the emergency/OPD. The incidence of repeated episodes, the level of awareness and usage of EPD were evaluated.

Results: All patients in the prospective study were male. The mean age of our study population was 35 ± 10.2 (range 18-58) years. These patients underwent CFB removal and topical antibiotic drops were prescribed. 46 (37.7%) patients had history of one or more previous episodes of similar injury with superficial CFB in the same or other eye. 76 (62.3%) patients presented with CFB for the first time. Of these 46 patients, 30 (65.2%) presented with second episode and 16 (34.8%) presented with third episode. Despite good level of awareness (86.9%) about eye-protection, most workers were negligent and did not use EPD while at work. Ten (21.7%) patients had been using EPD regularly, 12 (26.0%) occasionally and 24 (52.2%) gave history of no use of EPD. Eighteen patients (39.1%) had a history of attempted removal of foreign bodies by self/co-worker/local general practitioner. Our study demonstrates the careless attitude of the senior/supervising staff as with 3 (6.5%) patients were from the supervising group. Also, 38 (82.6%) patients admitted the fact that there was no strict supervision at their work-place.

Conclusion: The study reveals that workplace hazards need to be taken seriously and workers need to adopt preventive measures according to comprehensive safety guidelines. Awareness programs should be undertaken to educate workers regarding safety measures. Adoption of safety measures by the workers may significantly decrease the incidence of corneal injuries and ocular morbidity.

Keywords: Corneal foreign body; Corneal injury; Eye-protection device

Introduction

Workplace related ocular injuries constitute a major cause of eye trauma and may cause significant morbidity [1]. In south India, around 7.5% of the population has history of eye injury and workplace related injuries is most commonly seen [2]. In Aravindan comprehensive eye study from the same region, ocular trauma had a lifetime prevalence of around 4.5% even higher than other common eye conditions [3].

Superficial CFB is the most common, serious but preventable occupational hazard [4]. It is seen very commonly in those working in metal industry and construction workers [5]. Welding, metal cutting/ grinding have one of the highest risks of eye injuries as these as direct ocular injuries from flying fragments and thermal injuries due to sparks. Reports from world over show good awareness about eye protection but record low usage of EPD.

We aim to determine the incidence of repeated CFB injuries and the attitude of workers about use of EPD in small scale metal industry. Counseling/motivating the workers for constant use of EPD and training of their employers is the need of the hour. Here we suggest few EPD designs which are easily available and already in use in many countries, so that the incidence of ocular injuries can be decreased. Serious steps should be taken to bring all such workers under one roof by maintaining a proper registry system and provide them with high quality protective equipment by appropriate agencies. This is important as its consequences like corneal scars or infective keratitis can have detrimental effects on vision.

Materials and Methods

This prospective study included a series of one hundred and twenty-two consecutive patients who presented with a CFB injury to the out-patient/emergency department in a sub-urban locality in Bangalore city of South-India from 1st October 2017 to 31st March 2018. The locality has a lot of small-scale industries which involve welders, grinders, metal cutters and construction workers. The study was

approved by the Institute Ethics Committee of the hospital and followed the principles of the Declaration of Helsinki. A part of the study was presented as short-term research for Association of Community ophthalmologists of India (ACOIN) for the year 2017.

All cases underwent detailed examination including slit-lamp biomicroscopy, detailed history and best corrected visual acuity. Details of the mode of injury, history of any previous injury similar to the presenting corneal FB and scars of any previous corneal FB in the same eye or the other eye were noted. Patients were asked questions on their awareness regarding use of EPD.

26 × ½ gauge needle mounted on a 2-cc syringe was employed to remove the CFB with elimination of any rust ring. All patients were prescribed prophylactic antibiotic eye-drops in the form of Moxifloxacin 0.5% eye drops QID in the same eye for 1 week with follow-up in 2 days. For patients with severe pain, photophobia after CFB removal, patching was done after instilling Homatropine 2% eye drops and oral analgesics were prescribed for 2 days. These patients were told to start treatment after removal of eye-patch in 2 hours and asked to report for re-evaluation next day.

Results

A total of 122 patients were enrolled in this study. All patients in the series were male and the age ranged from 18 to 58 years. The mean age of our study population was 35 ± 10.2 years. 46 (37.7%) patients had history of one or more previous episode of similar injury with superficial CFB in the same/other eye. Of these 30 (24.6%) patients had a second injury and 16 (13.1%) patients had two or more similar injuries (Table 1). Majority (86.9%) patients were aware of the role of EPD at work-place.

The various modes of injuries are shown in Table 2. The most common mode of injury in the repeated CFB injury group was grinding seen in 20 (43.5%) patients. Eighteen (39.1%) injuries occurred during welding which was the second most common mode of injury followed by hammering (13%) and drilling/cutting of metal (4.3%). Three patients (6.5%) had injury while supervising the work.

The duration of EPD use while working is shown in Table 3. Ten (21.7%) patients used EPD regularly, whereas 12 (26.0%) patients used it only sometimes. Fifteen (32.6%) patients did not use EPD at all and 9 (19.6%) patients gave answers which were considered unreliable.

The barriers in EPD use reported by workers are shown in Table 4. Eleven (23.9%) patients reported unavailability of EPD around the work-place and nine (19.6%) felt it is non-beneficial. Four (8.7%) patients felt awkward using EPD and 12 (26%) reported the available EPD designs as expensive. Most patients (82.6%) reported no strict regulation at workplace (Figure 1).

Eighteen patients (39.1%) had a H/O attempted removal of foreign bodies by self/co-worker/local physician. 10 (21.7%) of these patients still had the foreign body and 6 (13.0%) patients had significant iron rust ring at the site. One (2.2%) patient each had linear corneal abrasions and recurrent corneal erosion with history of attempted removal by sharp edge of a paper at workplace (Table 5).

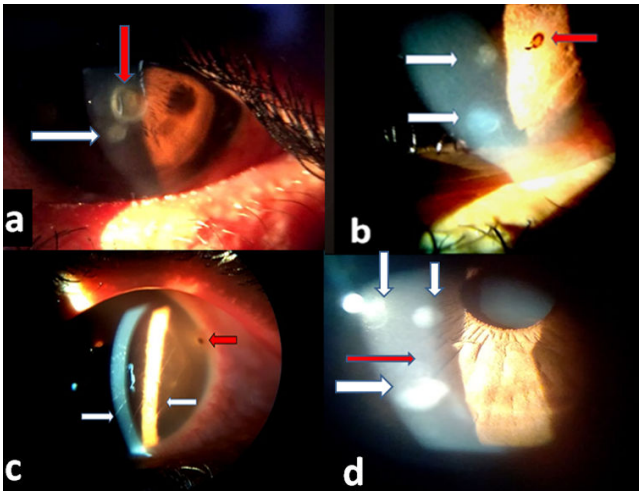

Figure 1: (a) Epithelial defect post removal day 1 (Red arrow), Old scar of previous CFB (White arrow) (b) Rust ring of CFB post attempted self-removal (Red arrow) with 2 old scars of previous cfb post removal (White arrows) (c) CFB (Red arrow) with linear epithelial scars due to attempted self-removal and history of cfb other eye (White arrows) (d) Healed epithelial defect post removal day 3 (Red arrow), Multiple old scars of previous CFB injuries (White arrows).

Number of Superficial Cfb Episodes		
1	First episode	76/122 (62.3%)
2	Second episode	30/122 (24.6%)
3	More than two episodes	16/122 (13.1%)

Table 1: Number of superficial Cfb episodes.

Mode of Injury		
1	Grinding	20/46 (43.5%)
2	Welding	18/46(39.1%)
3	Hammering	6/46 (13%)
4	Drilling/Cutting	2/46(4.3%)
5	Supervising	3/46 (6.5%)

Table 2: Mode of injury.

Duration of EPD Wear by Workers		
1	Using regularly	10/46 (21.7%)
2	Using sometime	12/46 (26.0%)
3	Not using at all	15/46 (32.6%)
4	Unreliable answer	9/46 (19.6%)

Table 3: Duration of EPD wear by workers.

Barriers Reported by Workers		
1	Unavailability	11/46 (23.9%)
2	Felt it is non-beneficial	9/46 (19.6%)
3	Felt shy/awkward	4/46 (8.7%)
4	Expensive to buy	12/46 (26%)
5	No strict regulation at workplace	38/46 (82.6%)

Table 4: Barriers reported by workers.

Cfb Removal by Self/Co-worker/Local Physician		
1	H/O Attempted removal	18/46 (39.1%)
2	Residual foreign body	10/46 (21.7%)
3	Residual iron rust ring	6/46 (13.0%)
4	Corneal abrasions	1/46 (2.2%)
5	Recurrent corneal erosion	1/46 (2.2%)

Table 5: Cfb removal by self/co-worker/local physician.

Discussion

Ocular injury due to superficial CFB of metallic nature is a common occupational health hazard [6-8]. Recurrent CFB though rare have been reported in the literature. Incidence of recurrent CFB has already been reported. In our study of 122 cases of CFB, 46 (37.7%) had recurrent CFB.

Corneal foreign bodies are divided into two categories, superficial (epithelial) and deep (involving Bowman's membrane or deeper but not Descemet's membrane). Healing of the corneal wound after removal of CFB does not leave a permanent scar unless it involves Bowman's membrane or deeper layers. In these cases, the wound is explored deeper to epithelium. The term "repeated" superficial CFB injuries is important as it denotes that no serious measures were taken to avoid injury even after the first episode. This exposes the careless and ignorant attitude on eye-protection in small-scale metal industry workers.

In most published reports, the disparity between high awareness and the actual use of EPD is evident. This difference between awareness and use of EPD is almost same in the developing and the developed world. Ajayi et al. in a study done among welders in Nigeria reported great awareness (90.6%) about the eye-protection devices but less than half (45.9%) of the workers had some device & of these only 9.6% used eye-protection all the time [9]. Our study shows similar findings with 40 (86.9%) patients showing good awareness. Although only 10 (21.7%) patients used EPD regularly (Table 3).

Three studies from the developed world shed light on the ignorant attitude towards use of EPD [10-12]. Despite almost 10 years gap between these 3 studies, the findings regarding the usage of EPD is similar. In the study done in automobile industry in USA, it was found that only about one-fourth of workers (24.9%) used EPD at the time of injury [10]. Similar results were recorded in the study by Voon et al. in Singapore where almost 4/5th of the injuries (78.6%) were due to unprotected eyes at the time of injury [11]. In the third study from Australia the authors found that only 45% of the patients using protective glasses at the time of injury. More importantly only around 50% of the patients who had a previous history of corneal FB, used safety devices at the time of latest injury which the authors said was "despite the high safety emphasis in the industrial workforce" [12]. This attitude is a major cause of concern and the training in eye-protection measures is very important [13].

Worldwide, in around 21-31.4% patients, the exact cause of vision loss could not be ascertained [14,15]. Poor system of reporting of ocular injuries and lack of national data on work-related ocular injuries in the developing nations like India could be the factors responsible. The other reason may be that in most such countries, majority of workforce in such industries are not registered [7]. Also, most of construction and industrial workforce is employed in small scale sectors with no strict rules and regulations. The implementation of safety norms by employers is also inadequate.

Prevention of recurrences of CFB and proper management may decrease prevalence of corneal blindness. Creating awareness among industry workers and forming laws to enforce preventive measures may go a long way in achieving these objectives. Studies have identified EPDs as the only factor providing protection from eye injuries at workplace [16,17]. We suggest 4 designs of protection devices which are already in use in various designs world over in some form (Figure 2). These may help to prevent CFB injuries and decrease the incidence.

Figure 2: (a) safety glasses-without side shields (b) safety glasses – with side shields (c) wide view safety goggles (d) face shield type "b".

The safety glasses without side shields (Figure 2a) are very cheap in cost and most easily available. The safety glasses with side shields (Figure 2b) offer more protection and easily available in most hospitals in India as post-operative glasses. The wide view safety goggles (Figure 2c) are available in sports shops as swimming goggles and can fit over prescription glasses. The face shield (Figure 2d) is easily available with shops selling driving helmets. These offer the widest area of protection.

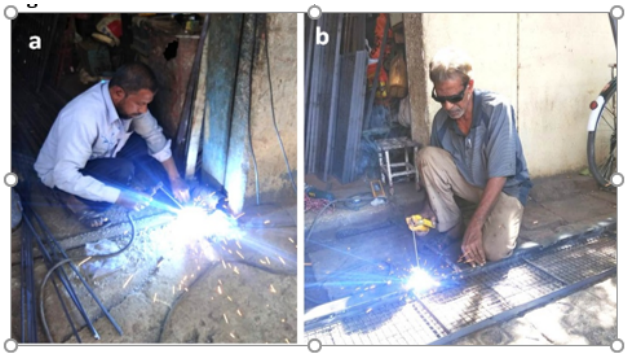

Figure 3: (a) A welder working without any safety eyewear **(b)** A welder using EPD after motivation.

The designs of EPDs mentioned here do not have venting holes which are a known cause of fogging of EPDs as mentioned by Chatterjee & Agrawal in a recent study involving agriculturists from India [18]. Also, designs 1 and 2 (Figures 2a and 2b) do not have head strap which may lead to slippage during usage. Although, these two barriers were the most commonly reported barriers in safety eyewear usage in the study mentioned above but unlike agriculturists, our study population does not require long hours of usage and bending from waist. Hence, fogging and slippage are rare possibilities. The advantage of designs 2, 3 and 4 (Figures 2b-2d) is that all these can accommodate prescription glasses as well. These EPD designs can be taken up for further modification by manufacturers but they should keep the cost factor in mind as in our study 12/46 patients (26%) could not afford the available EPD in their area which is an important cause of non-usage of EPD in the developing countries.

Various barriers which hamper regular use of safety eyewear have been categorized and discussed by various authors [19,20]. In our study, 9 (19.6%) patients felt it was not useful to use EPD and 4 (8.7%) patients felt shy/awkward using EPD. Our study shows non-seriousness of supervising staff as well, with 3 patients (6.5%) being from this senior group themselves. Also, 38 of 46 patients (82.6%) reported no strict supervision at the workplace leading to irregular or no use of safety eyewear. This attitude of workers can be changed by strategies like motivating workers in the community, distributing EPDs and counseling industry unit owners & supervisors to strictly ensure safety eyewear use as mandatory.

The workers should be advised to avoid any efforts of CFB removal themselves or by local general physicians and to report to ophthalmology emergency/OPD. Eighteen (39.1%) patients gave history of removal of foreign body at workplace by self/co-worker with the help of edge of new currency note or a paper (Table 5). Ten (21.7%) patients had residual foreign body, 6 (13%) patients had residual iron rust ring. The sharp cut on the cornea may lead to incomplete removal and infection. This type of mechanical trauma is one of the major causes of recurrent corneal erosion seen in 1 patient (2.2%) in our study [21]. The sharp edge of paper/currency note causes damage of epithelial basement membrane leading to defective adhesions at hemi-desmosomes diagnosed clinically by loose epithelial areas on slit lamp examination and patients presenting with mild to severe pain especially on waking up. Infective keratitis is a major cause of corneal blindness in developing countries. One should always carefully record signs of infection like sub-epithelial infiltration, persistent pain/photophobia and then start appropriate treatment. Culture can also be done for exact diagnosis of underlying micro-organism.

The study has various limitations which should be mentioned here. The study population has been taken from a smaller area and it would be ideal to cover a larger area. A recall bias in the questionnaire-based survey may have confounded the results. These simple designs are only to protect from projectile foreign body injuries and offer no protection from radiation related ocular injuries. It should be noted that modification of these designs are already available as anti-light radiation welding goggles in many countries. Our aim is to re-emphasize on the already available EPD options and make their availability in the developing countries easier.

Safety training should be given to such workers by routine visits to the industry units. This should be done by community health workers, community physicians, ophthalmologists in government/private hospitals and teaching medical colleges (Figure 3). The need of the hour is to record corneal trauma cases and maintain ocular trauma register in every institute. The data should be reported monthly/quarterly to a state/national level agency of the respective developing nation.

Conclusion

The setting of the study in small-scale industrial area makes the findings relevant to similar population in the developing countries. Workplace hazards need to be taken seriously and preventive measures according to comprehensive safety guidelines should be implemented. Routine awareness programs should be undertaken by community physicians and ophthalmologists. Corneal trauma register for frequent reporting to a national agency should be maintained. This can help to significantly decrease the incidence of corneal injuries and ocular morbidity.

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