Work-Related Ocular Injury: Causes, Symptoms, Signs and Prevention

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ABSTRACT

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| The incidence of work-related ocular injury (WROI) has been increasing over the past decades due to rapid industrialization globally. It has significant impact on morbidity to both patients and nations. Temporary or permanent visual loss following WROI can have great negative impact on patient’s physical, psychology and social implications, together with reduction in economic growth of a country. WROI occurs more in developing countries, affecting the younger male with lower socioeconomic status. The mechanism of WROI include physical, mechanical, chemical, electrical, thermal, biological and psychosocial hazards. Recognizing sign and symptoms of WROI with early referral is necessary to prevent long term visual impairment. A good visual rehabilitation is important for patients to minimize visual disability and to regain a good quality of life. Both the employers and workers play an important role in preventing WROI with proper education, training and implementation of workplace safety rules and regulations. The aim of this paper is to highlight the common causes, symptoms and signs of WROI and prevention aspect of this problem. Awareness of this issue in the community can help to reduce the cost and long-term financial burden in the community. |

***Keywords:*** *Work-related, ocular, injury, prevention*

1. INTRODUCTION

Globalization and industrialization in many developing countries including Malaysia in the past 20 years lead to rapid economic growth but it is also associated with increase in work-related injury, including ocular injury has been increasing over the years. Work- related ocular injury (WROI) has become one of the most common ocular traumas which contributed to 38.5% of all ocular trauma, followed by road accident 20.5% and sports injury 29% (Serenken M, 2013). There was estimation of 55 million ocular injuries occur worldwide annually, where 2.3 million results in low vision and 1.6 million results in blindness (Soong TK, 2011).

WROI has significant morbidity especially when it resulting in temporary or permanent visual loss subsequently lead to poor quality of life. This further affect socioeconomic status and psychological well-being of the patient. Financial loss in patient and their family as the victim might loss the job due to visual impairment. Overall, it may lead to loss of manpower for the nation and affecting economic growth of the country.

2. Prevalence of work-related ocular injury

Centers for Disease Control and Prevention reported that each day would have approximately 2000 workers in the United States experience WROI (Zakrzewski H, 2017). Studies published from Singapore and India in 2006 showed that WROI contributed to 56% of all ocular trauma in the Asia-Pacific region. Taiwan in 2008 and China in 2012 are reported prevalence of ocular trauma was 48% and 47% respectively. Published data in Malaysia showed 44% of WROI in 2011. (Wiwanitkit V, 2015). Another study in East Malaysia showed 36.9% of WROI (Omar R, 2022). In Malaysia, the distribution of ethnicity affected by WROI are Malay 31.9%, followed by Indian 12.2%, Chinese 9.7% and others 2.1% (Omar R, 2022). Male affected by WROI was 98.2% and mostly are between 21 to 30 years old (Ahn JY, 2020). Younger males are affected more in WROI as they are in occupations that are high risk in WROI such as industrial related work.

Developing countries have higher prevalence of WROI compare to developed countries. Taiwan and China reported WROI account for 40% of injuries whereas in Italy and United States, WROI ranges from 5-25% (Omar R, 2022). This difference is due to the standard measure of precaution is at high qualities in developed countries. Furthermore, WROI also tend to occur in lower socioeconomic condition where countries do not have sufficient financial support to provide good qualities of protective materials. Lower socioeconomic also leads to lack of training and educational support which causes workers expose to higher risk of WROI. Besides this, temporary of immigrant workers and illegal employees also contribute to these factors.

3. Common Causes of WROI

Common causes that lead to WROI include both worker factors and workplace factors. Studies showed that 46.4% was due to worker factors and 19.4% was due to workplace factors. (Serinken M, 2013). Example of worker related factors are careless, hurrying and not well trained. Careless remained the commonest cause due to rushing to complete his works, distracted by other workers, accidentally knocked down by others and fall. Workplace related factors are lack of protective equipment and improper workplace physical condition such as untidiness, slippery floor and heat. Lack of protective equipment is the commonest cause either the equipment is not available or the workers are not using them. This showed that workers might underestimate and neglect the importance of protective equipment (Serinken M, 2013). Other factors include lack of awareness on the associated risk within the scope of their work such as welding, hammering and cutting metals or wood.

**4. Mechanism of WROI**

WROI could be due to multiple factors such as physical, mechanical, chemical, electrical, thermal, biological and psychosocial hazards. Mechanical injury during grinding and welding work is caused by foreign bodies such as dust or debris that impact and injured the eye. Grinding contributed to 17.9% of WROI in one of the studies (Zakrzewski H,2017). Thermal injury is caused by burning, explosion and radiation, which is 2.7% (Nyo Nyo Min et al, 2016). Chemical injury reported was 31.4% in a published study, caused by acid or alkaline solution splash (Zakrzewski H, 2017). Biological hazards are caused by woods and plants particles. Others types of injuries sustained are from sharp-objects such as metals, nails and sawing. Another study in Malaysia reported WROI due to grinding metal (15.8%), welding (6.9%), hammering (3.7%), carpentry (2.6%) and nailing (1.8%) respectively. (Omar R, 2022)

**5. Symptoms of WROI**

When patients present with acute symptoms suspected of WROI the treating doctor need to obtain a detail history, both the symptoms and occupational history. The symptoms of WROI very often are acute onset and they usually occur at work. Some patients may present later due to milder symptoms. Frequent complaints are eye redness, eye pain, tearing, photophobia and blurring of vision. More serious presentations include severe pain, bleeding and total loss of vision.

Occupation history need to obtained includes nature of work, duration of work, exposure and use of protective equipment. Location and witnesses during the incident and any history of psychiatric disorder and previous injury should be obtained (Varacallo M, 2023)

Presenting symptoms commonly related to underlying anatomical injury. Eye pain and redness caused by foreign body such as dust particles in welding would suggest a corneal abrasion. Other associated symptoms are foreign body sensation during blinking, tearing and blurring of vision (Peate WF, 2007). Symptoms such as eyelid swelling, eye itchiness and eye redness with serous discharge seen among animal handlers or farmer common point to allergic conjunctivitis due to exposure to animal fur, common spices, fruits and vegetables (Peate WF, 2007). Associated symptoms are wheezing, rhinitis and eczematous skin rash.

Patients whom work at chemical, petroleum, manufacturing or household cleaning industry present with eye redness, pain and tearing commonly related to chemical splash injury, which can be acid or alkaline. Alkaline injuries are more common than acidic injuries as alkaline are widely use in domestic and industrial solution. Alkaline injuries are much more dangerous than acidic due to their lipophilic properties which causes penetration of ocular tissue through saponification of membrane lipids (Akgun Z, Selver OB, 2023).

Ocular mechanical trauma is divided into blunt trauma and open penetrating injury. It was reported blunt trauma is 6.83% and open penetrating injury is 8.41% (Nyo Nyo Min et al, 2016). Patients present with eyelid swelling, bruises, redness, severe eye pain and blurring vision must suspect blunt trauma. Blunt trauma occurs when tools or heavy objects hit the globe, which may cause blow out fracture concurrently. If blow out fracture occur, diplopia with or without eye movement is seen. Partial or total loss of vision would suggest hyphemia, lens dislocation and optic nerve avulsion whereas curtain- like loss of vision would suggest retinal detachment (Mohseni M, et al, 2024).

Severe eye pain and bleeding from the eye after grinding, hammering, nailing or sawing suggestive of penetrating open globe injury which require immediate intervention. If patient complains of water coming out from the eye, this is suggestive of aqueous humour leakage.

**6. SIGNS of WROI**

Detail ocular evaluation includes examination of visual acuity, optic nerve function test, intraocular pressure, anterior and posterior segment. The main aim is to determine the severity of ocular injuries. Corneal involvement with laceration is the major anterior segment injuries, followed by conjunctiva injury (Thevi T, Basri M, Reddy S, 2012). Examination of the cornea is crucial to diagnose cornea injury. If presence of epithelial defect, it will take up fluorescence stain which indicate a corneal abrasion. Presence of cornea infiltrate and opacity suggest a corneal ulcer likely due to foreign body. In examination of the conjunctiva, if the patient has lid edema, conjunctival injection, chemosis and cobblestone papillae on inspection by lid eversion indicate an allergic conjunctivitis, commonly seen in farmer and animal handlers. (Denniston 2014)

In chemical injury, common signs are conjunctival injection, chemosis and corneal generalized opacity due to edema. Limbal ischemia, anterior chamber cells, flare and fibrin are seen on slit lamp examination (Denniston 2014). Intraocular pressure commonly increases due to anterior chamber cells activity caused by acute inflammation. Thermal injury or burn due to electric or flame can result in second or third degree burn. In second degree burn, eyelid usually present with erythematous skin with blister and weeping whereas third degree burn eyelid usually present with dry leathery skin and reduce sensation (Warby R, Maani CV, 2024). Thermal injury may also present with keratopathy, which ranges from mild punctate defect to severe cornea permanent opacification, cornea melting and perforation (Denniston, 2014). Patient with blunt ocular trauma presents with periorbital edema, bruises, subconjunctival hemorrhage and hyphema. Slit lamp examination of anterior chamber may show cells and flare, associated with increase in intraocular pressure. Iris examination may reveal traumatic mydriasis, iris sphincter rupture and iridodialyis. Lens involvement commonly result in subluxation or dislocation. Posterior examination commonly reveals vitreous hemorrhage, commotio retinae, retinal detachment and macula hole (Warby R, Maani CV, 2024). Reduced in optic nerve function may suggest an optic nerve avulsion. Reduced in extraocular muscle movement may suggest of orbital wall fracture with muscle entrapment.

Examination of a patient reveal sharp metal fragment seen with injury penetrating from anterior to posterior indicate open globe injury. In such situation, the cornea and scleral often perforated, which require emergency intervention. Positive Seidel’s test indicates leakage of aqueous humour in open globe injury (Blair K,2024).

**7. Long term complications and Cost involved in WROI**

There are long term morbidities due to WROI. Among the common reported long-term complications are permanent reduce in vision from mild to moderate and total loss of vision is the most serious which affect quality of life. Besides physical impairment, other complications include social aspect such as loss of job leading to loss of income, social isolation due to inability to take part in social activities, and finally combination of all these factors can lead to psychological consequences such as anxiety and depression.

Visual outcome is poor in open globe injuries as compared with other types of WROI (Nyo Nyo Min et al, 2016). Workers with poor visual outcome would further neglect their works as they are difficult to adapt the poor visual state with further lead to frustration when performing the job. They have to use more effort to complete a given task and thus lead to secondary physical complications such as fatigue and tension headache.

Overall cost involved in WROI can be tremendous. Besides loss of productivity in workers, medical and hospitalization cost lead to increase economic burden of a country. It was reported that the direct cost of injuries for medication, surgery and equipment for visual recovery such as spectacles and prosthetics amounted to about RM1 Million (US$300 thousand) per year whereas the indirect cost of injuries due to factors such as compensation costs and off days from work is RM4 Million (US$1 Million). If combination of treatment cost and loss of income in total it can go up to RM 12 Million (US$300 million) a year (Omar R, 2022).

**8. Prevention of WROI**

Education and training for both employer and workers remains the most important preventive aspect of WROI. They should be educated regarding benefits and importance of maintenance protective equipment as 90% of WROI could be prevented with these measures. Programs such as workplace eye safety and campaign to raise awareness and knowledge regarding prevention of WROI should be recommended. WROI is more associated with workers who neglect or lack of awareness in using protective measure in workplace (Serinken M, 2013)

Education for workers depends on the type of occupation they are working in. Outdoor workers have higher risk of macula degeneration due to frequently exposed to ultraviolet light should be encouraged to use sun glasses protection. Welder, grinder and laser industry workers shall be educated on wearing personal protective equipment (PPE) such as goggles and helmet to prevent foreign body, exposure keratopathy and laser- induced cataract. Low rate of using PPE among workers are associated with 66.9% of eye injury in the workplace (Soong TK, 2011). Rubber tapper must be educated on ways to prevent foreign body entering the eye causing fungal cornea ulcer (Peate WF, 2007).

Proper policy regarding safety should be implemented in workplace. Among the strategies, appropriate education on workplace safety and providing effective eye protection with selection of suitable PPE are key factors. Monitoring and cleaning solution for PPE should also be available at workplace.

Employers and workers should be trained regarding first aid measure such as emergency support when WROI occurred. Rinsing and irrigation with copious amount of water need to be given for patient with chemical injury on the spot. Treating clinicians or primary care doctor in the workplace should refer patients as early as possible to prevent delay in management and complications.

Managing environmental factors in the workplace such as slippery floor must be addressed. Pre-employment and annual checkup for workers should be performed to evaluate their fitness in relation to their occupation (Wiwanitkit V, 2015). Periodic review on intensity of work, mental and physical functional status of workers should be implemented. Continuation assessment of safety and health issue in workplace with development of effective prevention strategies could be carried out. Occupational Safety and Health Act (OSHA) should mandate that employers provide adequate eye protection for workers. Continuous and regular training programs to workers in workplace safety is mandatory and should be monitored by the authority.

**9. Visual Rehabilitation for WROI**

Following WROI, the victims should receive adequate appropriate visual rehabilitation. The objective is to achieve the best vision after correction if possible, such as using glasses, contact lenses, prisms or surgery depending on the type of injury (Omar R, 2022). One important aspect to take note is that the visual rehabilitation itself may take a long course and thus it has a financial implication to the victim. Proper support from employer or other organization may be necessary. In cases such as patient’s financial difficulty, seeking assistance from social welfare organization may be a solution. The employer may also need to assist the worker to get compensation from company insurance or Social Security Organization (SOCSO). With good rehabilitation, hopefully the worker is able to return to work as soon as possible and sustain a good quality of life.

10. Conclusion

The incidence WROI is increasing following rapid industrialization. This problem can cause tremendous physical, social and psychological trauma to patients and employer. Recognizing sign and symptoms of WROI and early referral is necessary to prevent long term visual impairment. Overall, both direct and indirect cost in WROI is very high and escalating. Both the employers and workers can play a crucial role is to have proper WROI preventive strategy and regular educational training for employee in enhancing their knowledge in prevention of WROI. Continuous monitoring from the health and safety authority to ensure proper implementation of workplace safety rules and regulations are necessary. With proper prevention strategies it is possible to reduce overall healthcare cost in managing WROI.

Authors’ Contributions

First author (Zhen-Hua Chin) initiated the idea, designed the paper structure and write up. Second author provided resources, content and editing. All authors read and approved the final manuscript.”

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