Original Article

Patient Care Guidelines of Ophthalmic Injuries During COVID-19: A Systematic Review

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Background: Coronavirus disease 2019 pandemic and lockdown have changed human behaviors and physician practice patterns. Trauma centers reported decreased numbers of injuries during the lockdown. Ophthalmic injuries are urgent conditions and may introduce risks to the health personnel during patient care.

Objective: To study the epidemiological trends and to review the guidelines of patient care regarding ophthalmic injuries during the present study period.

Materials and Methods: A systematic search was performed in PubMed, Scopus, Cochrane library, and all Web of Science databases. Duplicated and non-relevant articles were excluded. Thirty-eight articles were independently reviewed by all authors, conflicts resolved by consensus. Guidelines retrieved from ophthalmic associations were summarized.

Results: The pooled incidence of eye injury was 17.8% (95% CI 10.2% to 29.2%). Eight articles were included in the meta-analysis for changes in numbers of ophthalmic injury cases, which showed no statistically significant change of percentage of cases during the lockdown comparing with the pre-lockdown, Odds Ratio 1.653 (95% CI 0.826 to 3.309), p=0.155). Causes of trauma were mainly from gardening and home improvement projects. Corneal and external eye injury were the main diagnoses. Guidelines of ophthalmic injury patient care stated about the risk stratification, coronavirus disease screening, and the preventive measures to limit virus spread during the caregiving.

Conclusion: There was no significant reduction of the incidence of ophthalmic injury during the Coronavirus disease 2019 pandemic and lockdown period. The causes of injury were mainly from the stay-at-home activities. Therefore, the authors suggest that eye protection when doing home maintenance should be advocated to the public for preventive measures even when they are less exposed to the outside environment. When the injuries occur, the primary care at the emergency department should include risk stratification, screening, and prevention of virus spreading as the key roles in the ophthalmic injury patient care.

Keywords: Ocular trauma, Ophthalmic injury, Epidemiology, COVID-19, Coronavirus

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Coronavirus disease 2019 (COVID-19) was first detected in Wuhan, China, in December 2019. The disease then rapidly spreads across the continents to more than 200 countries around the world. As of 22 November 2020, WHO reported 57,882,183 cases and 1,377,395 deaths globally[1]. To curb the virus spread during the outbreak, most countries have implemented lockdown measures. Previous observations from trauma centers showed that the area lockdown had diminished injuries by up to 50% of cases[2,3]. Ophthalmic patient care brings patients and caregivers into close contact. Moreover, eye operations using high-speed instruments can be considered as aerosol-generating procedures[4]. Most eye departments rigorously restrict the service volume of elective patients and non-emergent conditions due to awareness of the risks posed. However, eye injuries require immediate attention. Cases in need of surgical interventions would inevitably increase risks to the personnel in the operating rooms. The objective of the present study was to systematically review the epidemiological trends of ophthalmic injuries and the guidelines regarding care of eye injuries patients during COVID-19 pandemic.

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Materials and Methods

The study protocol was exempted from the review by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University (Certificate of Exemption number 030/2020).

The authors searched the electronic databases on 20 November 2020 using search strategies as follows:

1. PubMed search terms: [COVID-19 AND (eye OR ocul* OR ophthalm*) AND (trauma* OR injur* OR trauma OR injury)] OR {COVID-19 AND ["Facial Injuries/therapy"(MAJR) OR "Facial Injuries/therapy" (MAJR)]}. This showed 83 results.
2. Scopus search terms: [(COVID-19) AND (eye OR ocul* OR ophthalm*) AND (trauma* OR injur* OR trauma OR injury)] OR (COVID-19 AND [(facial AND injur*) OR (facial AND traum*)] AND [LIMIT-TO (EXACTKEYWORD, "Human")] AND [LIMIT-TO (SRCTYPE, "j")]. This showed 821 document results.
3. Cochrane Library search terms: (Title Abstract Keyword: COVID-19 AND (eye OR ocular OR ocul* OR ophthalmic OR ophthalm*) AND (trauma OR trauma* OR injury OR injur*)) OR (Title Abstract Keyword: COVID-19 AND facial traum*) OR (Title Abstract Keyword: COVID-19 AND facial injur*). This showed eight results, which were six protocols, one special collection, and one article.
4. Cochrane COVID-19 Study Register search terms: (eye trauma, eye injury, facial trauma, facial injury, Journal article). This showed 46 matching studies.
5. Web of Science (all databases) search terms: Topic=[COVID-19 AND (eye OR ocul* OR ophthalm*) AND (trauma* OR injur*)] OR Title=[COVID-19 AND (eye OR ocul* OR ophthalm*) AND (trauma* OR injur*)] OR Topic=(COVID-19 AND facial injur*) OR (COVID-19 AND facial traum*) OR Title=(COVID-19 AND facial injur*) OR (COVID-19 AND facial traum*). This showed 93 results.

The literature search was not limited to any article type, date of publication, or language. Duplicated and non-relevant articles were excluded. The articles were first independently reviewed, and then discussed among the three authors. A consensus was reached before performing a meta-analysis. Random-effects model meta-analyses were conducted to generate pooled incidence of eye injury before and during COVID-19 as well as the percentages of mechanism of injury. All pooled estimates were provided with 95% confidence intervals (CIs). Heterogeneity was assessed using the I^2 index and the Q test p-value. The analyses were performed using the Comprehensive Meta-Analysis software version 2.0 (www.meta-analysis.com; Biostat, Englewood, NJ).

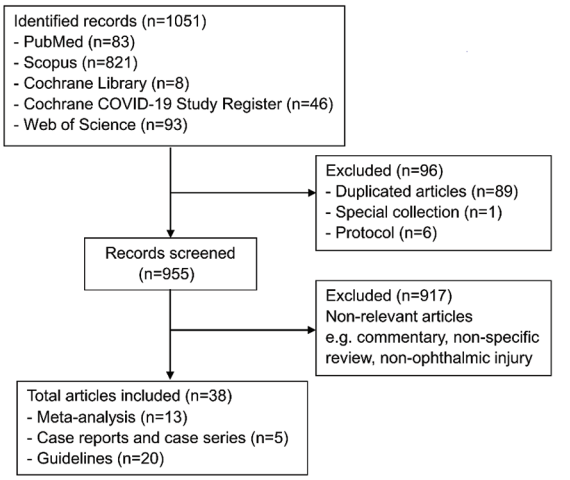

Figure 1. Demonstrates the numbers of articles in each step of systematic review.

The authors searched for the recommendations and guidelines for ophthalmologists with special considerations regarding ophthalmic injury from major ophthalmologists' associations official websites, such as from the United Kingdom Royal College of Ophthalmologists (RCOphth) website, the Royal Australian and New Zealand College of Ophthalmologists (RANZCO) website, the American Academy of Ophthalmology (AAO) website, and the Asia-Pacific Academy of Ophthalmology (APAO) website. Then, the authors reviewed, categorized, and summarized these recommendations and guidelines to finalize the present literature synthesis.

Results

One thousand fifty-one records were identified by systematic searching from the five major electronic databases. Thirty-eight articles were finally included in the systematic review and 13 articles were included in the meta-analysis. The numbers of articles in each step of review are shown in Figure 1.

Nine articles reported changes in numbers of eye injury cases during the pandemic by comparing the periods before and during COVID-19 lockdown. The first paper was a report from the ophthalmology emergency department, Birmingham and Midland Eye Centre in the U.K.[5]. The authors found increased number of cases with ocular injury during lockdown due to COVID-19 outbreak. Those were 23 cases out of 293 cases in a week of April 2020, compared with

10 cases out of 837 cases in 2019.

Another two studies were conducted by the same group of investigators in the Ophthalmology Unit of the S.Orsola-Malpighi University Hospital in Bologna, Italy[6,7]. Those studies were published at nearly the same time. However, the previous one included only ocular trauma cases during four weeks of the lockdown while the latter evaluated all cases visiting the ophthalmologic emergency department with an additional two weeks of observation. Due to its higher case number and longer study duration, only the data from the latter one was included in the meta-analysis to represent the results from their setting. There was a 27.5% decrease in the number of eye injury patients during COVID-19 lockdown in their institute[7]. The data from the former one[6] was used in the calculation regarding the mechanism of eye injury only.

Recently published papers from USA[8] and India[9] reported a decreased proportion of eye injury cases, whereas studies from Italy[10,11], Jordan[12], and Germany[13] reported an increased proportion of eye injury cases. Therefore, the authors included eight studies to analyze the change in epidemiology trends comparing before and during the pandemic lockdown.

In terms of mechanism of injury, Hamroush et al demonstrated that most cases resulted from gardening and home improvement projects[5], which was in agreement with the study from Pellegrini et al. Home activities, manual works, and gardening were found to be common mechanisms[6]. Regarding diagnoses, the proportion of diagnoses in the emergency category remained mostly unchanged, in which foreign body on external eye was the most prevalent cause (10.2%), followed by corneal abrasion (9.8%), and contusion of the eyeball (3.0%). A group of French ophthalmologists recently evaluated the use of teleconsultation to determine if ophthalmic emergency patients require further physical consultation during the lockdown[14]. Overall, 27% of teleconsultations required physical appointments. The triage result based on teleconsultation judgement was comparable to physical consultation, in particular diagnoses, which were able to be observed externally, ranging from corneal foreign body (13.8%) to major ocular trauma (1%).

The pooled estimates of percentages of mechanism of injury are shown in Table 1.

From the meta-analysis, the pooled incidence of eye injury from eleven articles[5,7-13,15-17] was 17.8% (95% CI 10.2% to 29.2%), I^2 index 99.2 (Egger test, p=0.06). For the severe cases, defined by the cases requiring surgical intervention or hospital admission, the pooled incidence calculated from four articles[8,11,15,18] was 4.1% (95% CI 1.8% to 8.8%), I^2 index 94.72 (Egger test, p=0.98). The comparison between the incidence of eye injuries before and during COVID-19, calculating based on the total emergency cases in the same period, did not show statistically significant change with the odds ratio of 1.653 (95% CI 0.826 to 3.309), p=0.155, using random effect model (I^2 index 97.47, p<0.001).

Table 1. The pooled estimates of percentages of mechanism of injury*

Mechanism of injury	Percentage (95% CI)	I^2 index	I^2 p-value
Gardening	26.2 (3.9 to 75.5)	94.51	<0.001
Home improvement	24.8 (15.6 to 37.1)	60.18	0.081
Violence	12.9 (2.3 to 48.0)	92.20	<0.001
Chemical injury	11.3 (4.5 to 25.3)	73.15	0.054
Falls	10.7 (0.5 to 74.7)	86.78	0.001
Sports/exercise	8.7 (2.9 to 23.1)	73.55	0.023
Others/unknown	18.9 (3.4 to 60.7)	91.75	0.001

CI=confidence interval

*Total number of studies=4[5,6,8,12]

Increased home activities during the lockdown may contribute to certain types of ocular injuries. Ophthalmic injuries resulting from "bow and arrow" role play imitating the television broadcast during COVID-19 lockdown were observed in two Indian children[19]. The conditions varied from corneal abrasion to penetrating injury of the eyeball. The authors suggested that to prevent the incidents, there should be warning messages integrated into these types of programs. Another two cases of ocular injuries were described during the lockdown in the U.K.[20]. Both were hit by an elastic band during home exercise, causing bilateral hyphema and commotio retinae. In one eye of a patient, a complex injury including a traumatic retinal break, vitreous hemorrhage, and macular hole were noted. This report highlighted the importance of bilateral eye examination as the injury may occur even in the unaffected eye.

As self-protective measures are continually being encouraged, the incidence of ocular injury associated with certain use of protective equipment either alcohol-based hand rub or facial mask is increasing accordingly. Cases of corneal epithelial defect secondary to alcohol-based hand rub gel were recently reported[21]. Conjunctival fornix swabbing and lid eversion are mandatory in these patients, given that alcohol gel can remain densely viscous and

difficult to be removed by normal saline irrigation alone. There was also a report describing a patient with orbital-subconjunctival-eyelid hemorrhage-hematoma[22]. The condition developed shortly after fitting the FFP2/NK95 facial mask, which possibly caused by the vessels rupture at the area where the pressure was applied.

The published guidelines and recommendations for ocular trauma practice during the pandemic retrieved from the systematic search and the ophthalmologists' associations websites were mainly focused on sight-threatening conditions requiring urgent or emergent care, patient screening for COVID-19 infection, and protective measures for health personnel. A summary of guidelines related to patient care regarding ophthalmic injury is shown in Table 2[23-48].

Discussion

The treatment of ophthalmic injuries cannot be deferred. Prompt evaluation and emergent procedures in these cases should be obtained since the delay would potentially result in permanent visual loss or life-threatening conditions. Ophthalmic health workers may increase their risks related to the aerosol-borne infectious diseases during patient service. The present study found the ophthalmic injury incidence was not significantly altered during the COVID-19 lockdown period. Therefore, the ophthalmic health providers should be well-prepared for the emergency situations to prevent themselves from contracting COVID-19.

Immediate consultant-level support should be available for ophthalmology injury service, to make prompt and appropriate decisions for triage and to take care of the patients. At the emergency department, all efforts should be put to generate a COVID-free track for patients in urgent or emergency conditions. These measures are to accelerate the treatment and to reduce the patients' fear of being infected in the hospital.

Teleconsultation is becoming a potential practice adopted in many areas of ophthalmology. Its use has been driven dramatically during the pandemic, given that it does not only help maintain the patient access but also reduces the risk of exposure to the virus among patients and health care providers. From the available evidence, teleconsultation is considered an effective screening tool for patients with ocular injury. It is also used to identify a patient who may have symptoms of COVID-19 before the entry to the hospital.

Regarding the infection control, in case of patients suspected of being infected, ophthalmic health care providers must work closely with the infection control personnel at the health care facility to limit the contamination of the virus during patient care.

Ideally, every patient should be screened for COVID-19 infection before the examination. The method includes using questionnaires to identify possible exposure to SARS-CoV2, obtaining nasopharyngeal swabs for RT-PCR, or serum antibodies in highly suspicious cases. However, testing usually cannot be completely done before triage. Therefore, when performing risk assessment and ophthalmic examination, appropriate personal protective equipment (PPE) is mandatory.

Generally, suppose there is a case of ocular emergency, aside from primary patient survey to address life-threatening conditions, the next critical step is to differentiate open from closed globe injury since each type determines the urgency of management and visual prognosis. Open globe injury is a full-thickness defect of the eyewall, which can occur due to penetration with point of entry into the globe but no exit wound, perforation with through-and-through, ruptured globe, or intraocular foreign body. Primary repair globe should then be performed without delay to prevent the risk of further tissue damage and post-traumatic endophthalmitis. For closed globe injury, a full thickness wound on the eyeball is absent. Closed globe injury can be further divided into ocular contusion and lamellar laceration. Both conditions usually result in ocular damage less in severity than an open globe and are frequently manageable with non-surgical treatment. In rare instances, some closed globe injuries can be complicated and challenging to manage such as when there is traumatic hyphema with uncontrolled intraocular pressure. In this case, scheduled surgery may be required.

The authors recommend that ophthalmologists reviewing the suggestive signs of open globe injury always consider the patient history of the mechanism of injury, as these might give a significant clue to the differentiation under the limited examination time.

If the surgery is needed, following infection control guideline is crucial because any asymptomatic patient can transmit the virus and screening test result is not always available prior to the time of surgery or even returns false negative. When undertaking urgent ocular surgeries, especially aerosol-generating

Table 2. A summary of guidelines related to patient care regarding ophthalmic injury

Theme	Recommendations
Prior to visit the emergency department	- Telephone or video call screening[23-31] - Entrance screening stations before entering the facilities[26,32]
Risk stratification of urgency/emergency conditions	The following conditions need to operate within 4 to 72 hours[33] - Open globe injury • Penetrating injury • Perforating injury • Intraocular foreign body - Closed globe injury • Traumatic hyphema with uncontrolled IOP - Orbital injury • Orbital fractures with entrapment of orbital contents, resulting in oculocardiac reflex[30,34-36], superior orbital fissure syndrome or orbital apex syndrome[32,37,38] • Orbital hemorrhage[29,30,35,38-40] - Ocular adnexa injury • Eyelid laceration[29,30,35,39] - Acute lacrimal drainage trauma[35,40]
COVID-19 screening	- Questionnaire[25-27,30,35,41] (fever, respiratory symptoms, close contact with confirmed case(s) of COVID-19 or travelled to areas with outbreak within 14 days) - Temperature checking[25-27,30,32] - Nasopharyngeal swab for polymerase chain reaction[27,28,34,39,40] - Serologic testing[40] - Chest computed tomography in highly suspicious cases with negative results from nasopharyngeal swab for polymerase chain reaction[41]
PPE and infection control	In outpatients or an accident and emergency department: - Maintain good hand hygiene[25,26,32,39] - Wear PPE[25-27,30,38,41-43] including disposable gloves, disposable plastic apron, surgical mask, N95 mask for confirmed COVID-19 or positive symptoms cases, eye/face protection - Use slit lamp breath guard[23,25,29,30,32] - Avoid air puff tonometry[26,32] - Patients must wear face mask or face covering[26] - Isolate patient with confirmed or suspected of COVID-19 in a single room[44] In operating theatre: - All medical staffs must wear proper PPE[34,35,39,43,45] including disposable gloves, disposable plastic apron or fluid resistant gown, N95 mask, and eye/face protection - Non-essential staff should not be in operating theatre[33,38,46]
Operating theatre management	- Operate in negative pressure ventilation operating theatre[32] - Avoid general anesthesia[29,30,35] - All staff except the anesthesia team should be outside the operating theatre during the time of intubation and extubation[42] - Use povidone iodine for surgical preparation[30,35,45] - Avoid aerosol-generating procedure[27,34,37-39,47,48] for example, avoid monopolar cautery for cutting or coagulation, use bipolar cautery for hemostasis in lowest power setting - Multi-specialty surgery should be performed in the same setting[33] - Use dissolvable sutures to reduce need for removal[46]
Post-operative management, cleaning/ disinfection	- Shift patient to isolation ward after surgery until risk stratification can be done[35] - Disinfect the room after the operation[26] - For equipment such as slit-lamp, autorefractor, disinfect with 70% to 75% ethanol or isopropyl alcohol[32] - For direct contact instrument, disinfect with either diluted bleach solution with sodium hypochlorite or 3% hydrogen peroxide for at least 5 minutes[32] - Few post-operative visits with limit in-person contact are recommended[31,33]

PPE=personal protective equipment

procedures, health care providers within the operating room should wear N95 masks, eye protection, disposable gloves, and fluid-resistant gowns. The choice of anesthesia may depend on the patient's

overall medical status and related procedures. After surgery, the patient may subsequently be moved to the isolation ward until risk stratification can be performed.

In a tertiary-care setting in Australia, a retrospective review of patients diagnosed with ocular trauma prior to the time of COVID-19 pandemic demonstrated that more than half of ocular injury was caused by alleged assault, followed by accidental injury and animal-related[49]. These findings were different from the major causes of injury during the COVID-19 pandemic and lockdown in the present report. Gardening and home improvement projects were the major causes since people staying at home during the lockdown might not protect themselves adequately, although there was a long-term national-level study from New Zealand showing that many preventable ocular injury cases were related to the lack of protective eyewear use[50].

People staying at home during lockdown period should be encouraged to protect themselves by wearing appropriate protective equipment such as face shields, goggles, or safety glasses when working with chemicals, grinding metal, and when involved in sports activities, to recognize symptoms related to eye emergency requiring immediate medical attention, and to be able to handle the conditions properly.

Several limitations of the present study should be addressed. The number of published studies is currently limited, and they represent only some parts of the world. Given high heterogeneity between studies, the pooled incidence estimate should, therefore, be interpreted with caution. Furthermore, the statistic and its 95% CI were calculated from aggregated data, not the individual-level data. It should also be noted that all COVID-19 guidances are subject to change and do vary from country to country. Until more is known about the exact mode of transmission, the authors urge the ophthalmologists to keep updating themselves and continue to implement the guidelines even in the re-opening period to minimize contagion risk.

Conclusion

In summary, the authors did not find the significant changes in the incidences of ophthalmic injuries during COVID-19 lockdown period. The recommendations and guidelines related to ophthalmic care for eye injuries during COVID-19 outbreak mostly described the risk stratification of conditions, COVID-19 screening, and preventive measures.

What is already known on this topic?

Coronavirus disease 2019 pandemic and lockdown have decreased the numbers of injuries during this period, as reported by trauma centers. Ophthalmic injuries are urgent conditions and may introduce risks to the health personnel during patient care.

What this study adds?

The pooled incidence of eye injury was 17.8%. There was no statistically significant change of percentage of cases during the lockdown comparing with the pre-lockdown. The main causes were from gardening and home improvement projects. Therefore, eye protective measures should be advocated. Corneal and external eye injury were the main diagnoses.

Conflicts of interest

The author reports no conflicts of interest in the present work.

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