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Research Article

Clinical Profile and Management of Chemical Ocular Burns at a Tertiary Eye Care Centre in South India: A Retrospective Observational Study

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ABSTRACT

Purpose: To describe the demographic profile, clinical characteristics, severity, and management of patients presenting with chemical ocular injuries at a tertiary eye care centre in South India between January 1, 2025, and December 31, 2025.

Materials and Methods: A retrospective observational study was conducted on patients presenting with chemical ocular injuries during the study period. Demographic details, mode and place of injury, laterality, presenting visual acuity, Roper–Hall grading, and treatment modalities were retrieved from medical records and analysed using descriptive statistics.

Results: A total of 47 patients (56 affected eyes) were included. The mean age was 33.6 ±14.9 years, and 74.5% were males. Alkali injuries were the most common mode of injury, followed by acid injuries, with the workplace (53.2%) being the commonest site of exposure. Unilateral involvement was observed in 80.9% of patients. Among the affected eyes, 55.4%had presenting visual acuity ≥6/12. Grade 1 chemical injury was the most frequent severity grade (53.6%), followed by Grade 2 (23.2%), Grade 4 (14.3%), and Grade 3 (8.9%). Medical management was sufficient in 85.1% of patients, while 14.9% required surgical intervention.

Conclusion: Chemical ocular injuries predominantly affected young working-age males and were most commonly workplace-related. Although most eyes had mild injuries and were managed conservatively, severe injuries requiring surgery were also encountered. Early ophthalmic evaluation and prompt management are essential to optimize visual outcomes.

Keywords: Chemical Ocular Injury, Acid/Alkali Eye Burns, Roper–Hall Classification.

INTRODUCTION

Chemical ocular injuries are ophthalmic emergencies that can result in severe ocular surface damage, permanent visual impairment, and blindness if not managed promptly.[1–3] They account for approximately 11–22% of all ocular trauma and continue to represent a significant public health problem worldwide, particularly among young working-age adults.[2,4] The severity of injury depends on several factors, including the nature of the offending chemical, its concentration, duration of exposure, and the interval between injury and initiation of treatment.[1,5]

Alkali injuries generally produce more severe ocular damage than acid injuries because hydroxyl ions rapidly penetrate the corneal stroma through saponification of cell membrane lipids, resulting in progressive tissue destruction, limbal stem cell deficiency, and anterior segment complications.[1,2,6] In contrast, acids usually induce coagulation necrosis, limiting deeper tissue penetration, although highly concentrated acids may also produce devastating ocular damage.[1,7]

Immediate copious irrigation remains the cornerstone of emergency management and is the single most important intervention influencing visual prognosis.[3,8] Subsequent treatment is directed toward controlling inflammation, promoting epithelial healing, preventing infection, and preserving limbal stem cell function. Severe injuries may require surgical procedures such as amniotic membrane transplantation, limbal stem cell transplantation, or ocular surface reconstruction to restore ocular integrity and vision.[2,5,9]

Several classification systems have been proposed to grade the severity of chemical ocular injuries, of which the Roper–Hall and Dua classifications are the most widely used. These systems aid in assessing prognosis, guiding treatment, and facilitating standardized reporting across studies.[3,10]

Although several international studies have described the epidemiology and management of chemical ocular injuries, data from India remain relatively limited, particularly from tertiary eye care centres in South India.[2,4,11] Regional variations in occupational exposure, household chemical use, healthcare accessibility, and treatment practices necessitate institution-specific data to better understand the clinical spectrum of these injuries.

Therefore, the present study was undertaken to describe the demographic profile, clinical characteristics, severity, and management of patients presenting with chemical ocular injuries at a tertiary eye care centre in South India over a one-year period.

MATERIALS AND METHODS

This retrospective observational study was conducted at a tertiary eye care centre in South India after obtaining approval from the Institutional Ethics Committee. Medical records of all patients presenting with chemical ocular injuries between January 1, 2025, and December 31, 2025 were reviewed.

Patients of all age groups presenting with acute chemical ocular injuries during the study period were included. Patients with incomplete medical records or those with ocular injuries unrelated to chemical exposure were excluded.

Demographic data including age and sex, mode and place of injury, laterality, presenting visual acuity, clinical findings, severity of injury, and treatment details were retrieved from the electronic medical records. Presenting visual acuity was recorded using a Snellen visual acuity chart whenever feasible and categorized into standard visual acuity groups for analysis.

The severity of chemical injury was graded according to the Roper–Hall classification. Laterality was classified as right eye, left eye, or bilateral involvement.

All patients received immediate ocular irrigation followed by comprehensive ophthalmic examination, including slit-lamp biomicroscopy and posterior segment evaluation whenever media clarity permitted. Treatment was individualized according to the severity of injury and included medical management with topical lubricants, antibiotics, corticosteroids, cycloplegics, antiglaucoma medications, oral vitamin C, and oral doxycycline when indicated. Patients with severe ocular surface involvement underwent appropriate surgical intervention.

RESULTS

A) Demographic Characteristics

Table 1: Age and sex distribution of patients with chemical ocular injury (N = 47)

Category	Subcategory	Numbers (N=36)	Percentage
Age group	0 - 10 years	4	8.5%
	11 - 20 years	4	8.5%
	21 – 30 years	9	19.1%
	31 – 40 years	19	40.4%
	41 – 50 years	7	14.9%
	51 – 60 years	3	6.4%
	61 – 70 years	1	2.1%
Sex	Male	36	76.6%
	Female	11	23.4%

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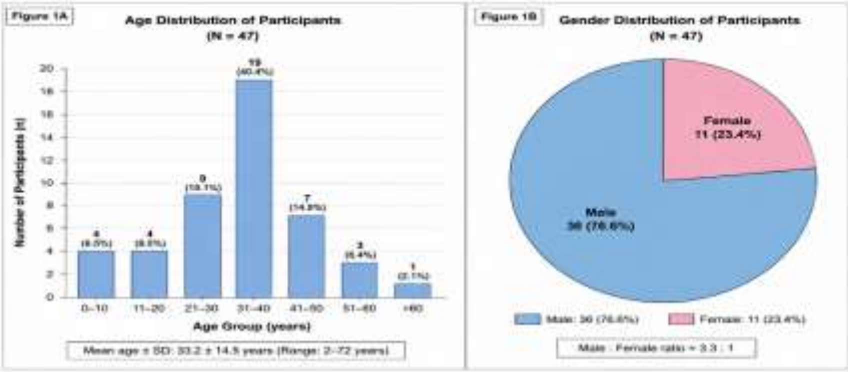
The study included 47 participants. The most common age group was 31–40 years (40.4%), followed by 21–30 years (19.1%). The mean age was 33.2 ±14.5 years (range: 2–72 years). (Table 1, Figure 1A) Males constituted the majority of participants (76.6%), with a male-to-female ratio of approximately 3.3:1. (Table 1, Figure 1B)

Figure 1. Demographic Characteristics of the Study Population



B) Mode of Chemical Injury

Table 2: Mode of burn injury among study participants (N = 47)

Mode of injury	Numbers	Percentage
Accidental fall of alkali	16	34.0%
Accidental fall of acid	10	21.3%
Accidental fall of floor cleaning agent	6	12.8%
Accidental fall of flower sap	3	6.4%
Accidental fall of Fevikwik	3	6.4%
Pepper spray by stranger	3	6.4%
Accidental fall of kerosene	1	2.1%
Accidental fall of cooking oil	1	2.1%
Accidental fall of insecticide	1	2.1%
Accidental fall of paint	1	2.1%
Accidental fall of cement	1	2.1%
Accidental fall of aluminum dust	1	2.1%

Alkali-related agents (including lime) were the most common causative chemicals, accounting for 16 patients (34.0%), followed by acid in 10 patients (21.3%) and floor cleaning agents in 6 patients (12.8%). Flower sap, Fevikwik, and pepper spray each accounted for 3 cases (6.4%), while kerosene, cooking oil, insecticide, paint, dry cement, and aluminium dust each contributed 1 case (2.1%). (Table 2, Figure 2)

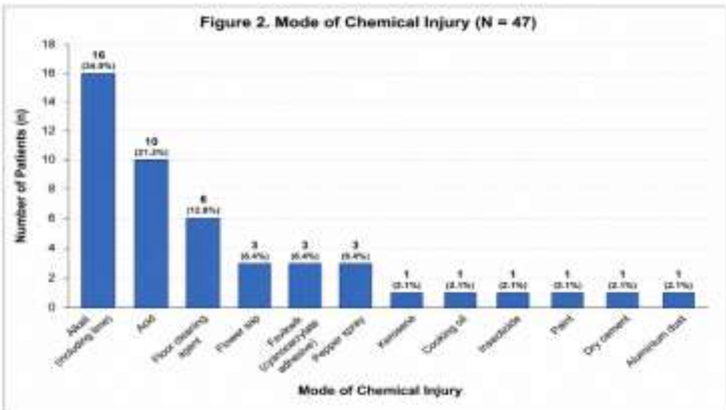


Figure 2. Mode of Chemical Injury among Study Participants

C) Place Of Injury

Table 3: Place of ocular burn injury among study participants (N = 47)

Place of injury	Numbers	Percentage
Work place	25	53.2%
Home	19	40.4%
Outside	2	4.3%
School	1	2.1%

The workplace was the most common site of injury, accounting for 25 patients (53.2%), followed by the home in 19 patients (40.4%). Injuries occurring outside and at school were less frequent, accounting for 2 (4.3%) and 1 (2.1%)patient, respectively. (Table 3, Figure 3)

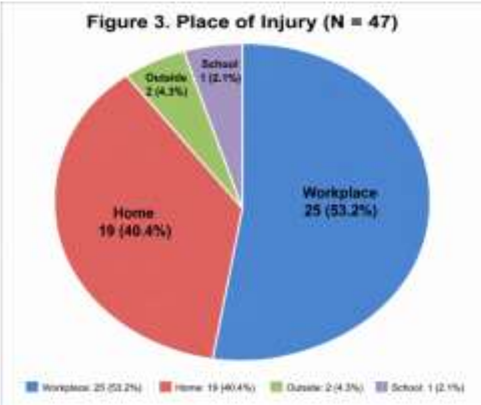


Figure 3: Distribution of type of firecracker causing injury

D) Laterality

Table 4: Laterality of chemical injury among study participants (N = 47)

Type of fire. Cracker	Numbers (N= 57)	Percentage
Both eyes	9	19.1%
Right eye	21	44.7%
Left eye	17	36.2%

Unilateral involvement was observed in 38 patients (80.9%), while 9 patients (19.1%) had bilateral ocular involvement. Among unilateral cases, the right eye was affected more frequently (21 patients, 44.7%) than the left eye(17 patients, 36.2%). (Table 4, Figure 4)

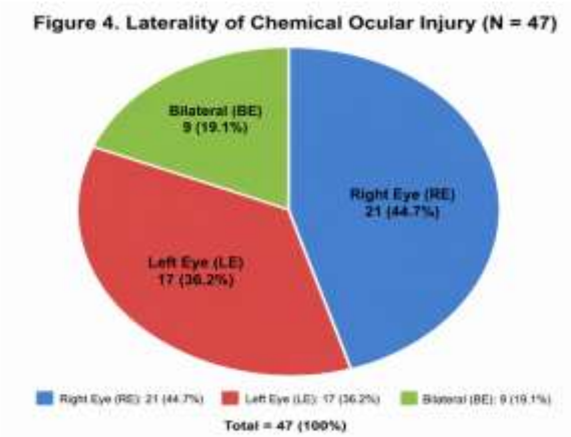


Figure 4: Distribution of laterality of chemical injury patients

E) Visual Acuity At Presentation

Table 5: Presenting visual acuity of affected eyes (N= 56)

Presenting visual acuity	Numbers	Percentage
>6/12	31	55.4%
6/12 -6/60	13	23.2%
6/60–3/60	5	8.9%
3/60 – PL +ve	4	7.1%
No perception of light	1	1.8%
Could not be assessed	2	3.6%

Among the 56 affected eyes, 31 eyes (55.4%) had a presenting visual acuity of ≥6/12, while 13 eyes (23.2%) had visual acuity between <6/12 and 6/60. Five eyes (8.9%) had visual acuity between <6/60 and counting fingers at 3 m, whereas four eyes (7.1%) had visual acuity ranging from <3/60 to perception of light (PL+). One eye (1.8%) had no perception of light (PL−), and visual acuity could not be assessed in two eyes (3.6%). (Table 5, Figure 5)

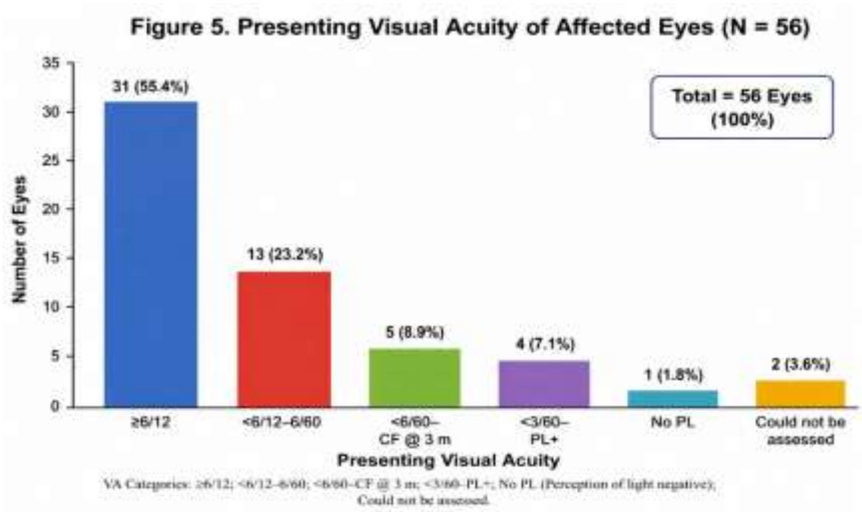


Figure 5: Distribution of Visual acuity at the time of presentation (N= 56)

F) Grades of Chemical Injury

Table 6: Roper hall grades among patients with chemical injuries (N =56)

Roper hall grade	Numbers	Percentage
Grade 1	30	53.6%
Grade 2	13	23.2%
Grade 3	5	8.9%
Grade 4	8	14.3

Among the 56 affected eyes, Grade 1 chemical injury was the most common, accounting for 30 eyes (53.6%), followed by Grade 2 in 13 eyes (23.2%), Grade 4 in 8 eyes (14.3%), and Grade 3 in 5 eyes (8.9%). (Table 6, Figure 6)

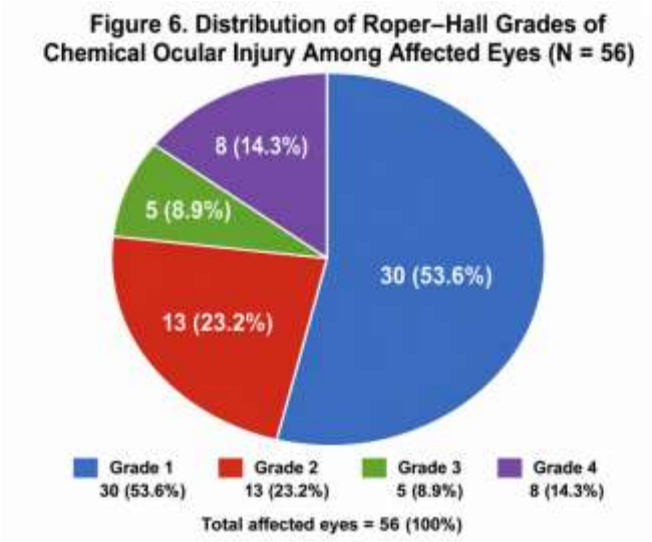


Figure 6: Distribution of Ocular findings at presentation in ocular burn patients

G) Treatment Modalities Provided

Table 7: Treatment modalities provided to ocular burn injury patients (N = 26)

Treatment category	Numbers	Percentage
Conservative	40	85..1%
Surgical	7	14.9%

The majority of patients were managed medically, with 40 patients (85.1%) receiving conservative treatment, while 7 patients (14.9%) required surgical procedures. (Table 7,Figure 7)

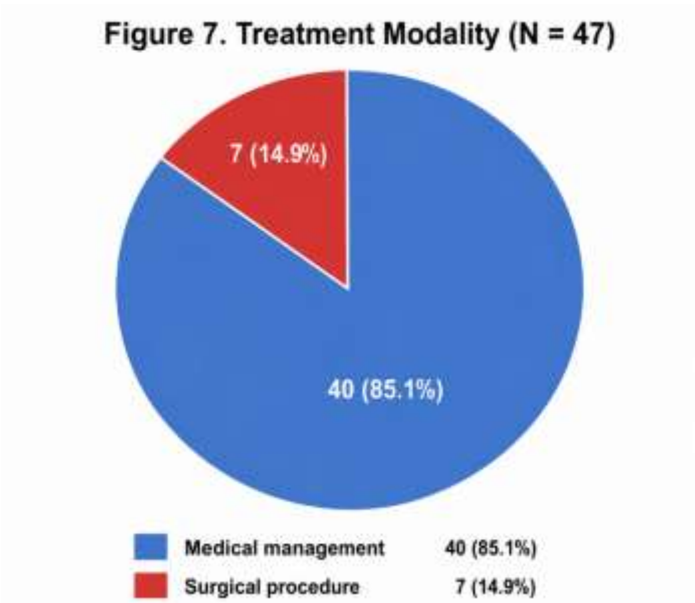


Figure 7: Treatment modalities provided to ocular chemical injury patients (N = 47)

DISCUSSION

Chemical ocular injuries remain a significant ophthalmic emergency because they can result in permanent visual impairment if prompt treatment is not instituted. In the present study, 47 patients with 56 affected eyes were evaluated over one year. The majority of patients were young adults, with a mean age of 33.6 ±14.9 years, and males constituted 74.5% of the study population. These findings are consistent with previous studies, which have demonstrated that chemical ocular injuries predominantly affect young working-age males because of greater occupational exposure to hazardous chemicals.[1–4,12]

Workplace injuries (53.2%) were the most common site of injury in our study, followed by domestic accidents (40.4%). Similarly, Madala et al. reported that most injuries occurred in workplace and field settings, emphasizing occupational exposure as the major risk factor for chemical ocular injuries.[12] In contrast, Allen et al. from New Zealand observed that most injuries occurred at home (62%), with cleaning activities being the commonest mechanism, reflecting regional differences in occupational practices, household chemical use, and workplace safety regulations.

Alkali agents, including lime, were the commonest causative chemicals in our series, followed by acids. This observation is comparable to the findings of Madala et al., who reported alkali injuries in 58.3% of patients and acid injuries in 21.3%.[12] Similar trends have been described in other studies, where alkali substances predominate because of their widespread use in construction, cement work, agriculture, and industrial cleaning products.[2–5] Alkali injuries are known to produce more severe ocular damage because of rapid penetration into the corneal stroma through saponification of cell membrane lipids.[1,3]

Unilateral involvement was observed in 80.9% of patients, whereas bilateral injuries accounted for 19.1%. Similar patterns have been reported in previous studies, with bilateral involvement generally resulting from accidental splashes or high-volume chemical exposure.[3,6]

More than half of the affected eyes (55.4%) presented with a visual acuity of ≥6/12, while only one eye (1.8%) had no perception of light. These findings suggest that most patients in our series presented with relatively mild injuries and received timely ophthalmic care. Allen et al. likewise reported that most patients had mild injuries with favourable visual outcomes, whereas severe visual loss was uncommon and was associated with delayed irrigation and more severe ocular surface damage.

Based on the Roper–Hall classification, Grade 1 injuries constituted 53.6% of affected eyes, followed by Grade 2 (23.2%), Grade 4 (14.3%), and Grade 3 (8.9%). Madala et al. similarly reported that Grade I and Grade II injuries accounted for the majority of cases, while severe injuries were relatively infrequent.[12] The predominance of low-grade injuries in both studies may reflect early presentation and prompt initiation of treatment. Conversely, the presence of Grade IV injuries in our study highlights the continued occurrence of vision-threatening chemical burns requiring intensive medical therapy and, occasionally, surgical intervention.

Medical management was sufficient in 85.1% of our patients, whereas only 14.9% required surgical intervention. This finding agrees with previous reports demonstrating that most mild-to-moderate chemical injuries respond well to intensive topical therapy, lubrication, corticosteroids, cycloplegics, and supportive measures.[1,2,8] Surgical procedures, including amniotic membrane transplantation and ocular surface reconstruction, remain reserved for severe ocular surface burns with persistent epithelial defects or limbal stem cell deficiency.[8,9,14,15]

The findings of the present study reinforce the importance of preventive strategies, particularly the use of protective eyewear in occupational settings, immediate copious irrigation following chemical exposure, and early referral to a tertiary eye care centre. These measures have consistently been shown to reduce the severity of ocular damage and improve visual outcomes.[3,7,13,16]

The present study is limited by its retrospective design, relatively small sample size, and lack of long-term follow-up data. Nevertheless, it provides contemporary data on the demographic profile, severity, and management of chemical ocular injuries from a tertiary eye care centre in South India and highlights the continued need for preventive education and timely ophthalmic intervention.

CONCLUSION

In the present study, chemical ocular injuries predominantly affected young adult males, with workplace exposure and alkali agents being the most common causes. Most patients presented with unilateral, low-grade (Roper–Hall Grade I) injuries and had good presenting visual acuity, with the majority being successfully managed with medical therapy alone. Nevertheless, a small proportion of patients sustained severe ocular surface injuries requiring surgical intervention, underscoring the importance of prompt diagnosis and timely management. These findings highlight the need for improved occupational safety practices and early referral to specialized ophthalmic care to minimize visual morbidity following chemical ocular injuries.

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Conflict of Interest: None

REFERENCES

1. Eslani M, Baradaran-Rafii A, Movahedan A, Djalilian AR. The ocular surface chemical burns. J Ophthalmol. 2014;2014:196827.
2. Sharma N, Kaur M, Agarwal T, Sangwan VS, Vajpayee RB. Treatment of acute ocular chemical burns. Surv Ophthalmol. 2018;63(2):214-235.
3. Clare G, Suleman H, Bunce C, Dua HS. Chemical eye injury: pathophysiology, assessment and management. Eye (Lond). 2020;34(2):200-219.
4. Akgun Z, Selver OB. Epidemiology and etiology of chemical ocular injury: A brief review. World J Clin Cases. 2023;11(6):1245-1251.
5. Wagoner MD. Chemical injuries of the eye: current concepts in pathophysiology and therapy. Surv Ophthalmol. 1997;41(4):275-313.
6. Morgan SJ. Chemical burns of the eye: causes and management. Br J Ophthalmol. 1987;71(11):854-857.
7. Merle H, Gérard M, Schrage N. Ocular burns. J Fr Ophtalmol. 2008;31(7):723-734.
8. Allen NE, Crawford AZ, McGhee CNJ, Meyer JJ. Chemical eye injuries: a 10-year retrospective review of acute presentations and clinical outcomes in Auckland, New Zealand. Sci Rep. 2024;14:8264.
9. Bizrah M, Yusuf A, Ahmad S. Current and upcoming therapies for ocular surface chemical injuries. Ocul Surf. 2019;17(1):48-59.
10. Dua HS, King AJ, Joseph A. A new classification of ocular surface burns. Br J Ophthalmol. 2001;85(11):1379-1383.
11. Cronbach N, Foot B, Scawn R. Severe ocular chemical injury in the UK: A British Ophthalmological Surveillance Unit study. Eye (Lond). 2024;38:2552-2556.
12. Madala P, Sangeetha T, Kruthika S. Clinical profile of ocular chemical injuries in a tertiary care centre of Kolar, Karnataka, India: A retrospective study. J Clin Diagn Res. 2023;17(4):NC01-NC04. doi:10.7860/JCDR/2023/61262.17679.
13. Allen NE, Crawford AZ, McGhee CNJ, Meyer JJ, et al. Chemical eye injuries: A 10-year retrospective review of acute presentations and clinical outcomes in Auckland, New Zealand. Sci Rep. 2024;14:8264. doi:10.1038/s41598-024-58670-y.
14. Agarwal S, Srinivasan B, Gupta R, Iyer G. Allogenic simple limbal epithelial transplantation versus amniotic membrane transplantation in the early management of severe ocular chemical injuries: A retrospective comparative study. Am J Ophthalmol. 2020;216:166-173.
15. Venugopal A, Gurnani B, Ravindran M, Uduman MS. Management of symblepharon with Gore-Tex as a novel treatment option for ocular chemical burns. Eur J Ophthalmol. 2024;34(6):1865-1874. doi:10.1177/11206721241238302.
16. Jha R, Sonwani P, Singh S. Early and intensive management of chemical eye injuries: Case series. Ophthalmol Res Int J. 2024;19(3):7-15. doi:10.9734/OR/2024/v19i3419.