Unusual ocular chemical injury from a dental whitening solution

Aadil Bharadia[1,2], Lucy Njambi[1]
[1]Department of Ophthalmology, Faculty of Health Sciences, University of Nairobi, Kenya
[2]Department of Ophthalmology, Coast General Teaching and Referral Hospital

Corresponding author: Dr. Aadil Mohamed Bharadia, Department of Ophthalmology, Faculty of Health Sciences, University of Nairobi, Consultant, Department of Ophthalmology, Coast General Teaching and Referral Hospital.
Email: baradiaaadil@gmail.com.

Funding: The authors did not receive financial support for this study.

Conflict of Interest: The authors had no conflicts of interest to declare.

Abstract

Introduction: Accidental ocular burns from the inadvertent use of substances packaged in plastic dropper bottles have been reported for decades and remain a clinical concern, as they may result in severe corneal injury. We report a case of a patient who mistakenly instilled dental whitening drops, causing a serious corneal burn. Prompt, aggressive management resulted in a favorable visual outcome.

Case report: An 11-year-old male patient presented with left eye pain, swelling, and reduced vision after accidentally instilling a drop of dental whitening solution (alkali) instead of Probeta-N (betamethasone 0.1% and Neomycin 0.5%). His mother rinsed the eye immediately and took him to a health facility, where further irrigation and eye drops (cyclopentolate 1%, diclofenac, and gentamicin) were administered before referral to Kenyatta National Hospital (KNH). At KNH, he was diagnosed with a left eye chemical injury (Roper-Hall grade 3) and treated with moxifloxacin 0.5% eye drops, cyclopentolate 1%, prednisolone acetate 1%, artificial tears, oral vitamin C, and a bandage contact lens. Our patient experienced good outcomes; visual acuity was 6/6 after 1 month, and during the first review, the corneal epithelium had fully regenerated. The primary factors influencing these favorable outcomes included timely and adequate irrigation, the amount of the caustic agent, and early presentation to the healthcare facility.

Conclusion: This case highlights the importance of proper labeling, patient education, and careful administration of eye drops to prevent such incidents. Chemical eye injuries due to mistaken use of medications can lead to severe ocular damage, potentially resulting in long-term visual impairment. Early recognition and prompt management are crucial in minimizing complications and preserving vision.

Key words: Ocular, chemical injury, dental whitening solution.

Introduction

Medication errors, defined as failures in the treatment process that may result in patient harm, are frequently attributed to drug name confusion, often due to similarities in spelling, phonetics, or packaging(1,2). Accidental ocular instillation of non-ophthalmic pharmaceutical products remains under-reported and insufficiently recognized in the international literature(3). Since the 1980s, the widespread use of plastic "eye dropper" bottles for packaging consumer products and non-ophthalmic medications has been associated with numerous cases of inadvertent ocular injury, typically resulting from their confusion with ophthalmic preparations. Despite more than three decades of repeated calls from ophthalmologists for the adoption of simple safety regulations, little progress has been made in reducing the risk posed by such packaging practices(4–13). Chemical injuries to the eye are an ophthalmic emergency whose prognosis depends on the type of chemical substance, the amount of the chemical, the degree of corneal involvement, and appropriate management(14). Chemical injuries involving the eye account for 11.5%–22.1% of ocular trauma(15,16). Chemical ocular burns tend to occur most commonly in males, younger age groups, and may produce extensive damage to the ocular surface epithelium, cornea, and anterior segment, resulting in permanent unilateral or bilateral visual impairment(17).

Chemical ocular burns can be caused by an alkali or an acidic agent(17,18). Chemical injury in this case was classified using the Roper-Hall classification, which is based on the extent of corneal involvement in conjunction with limbal ischemia(19).

This case presentation describes a patient who sustained a chemical eye injury after mistakenly using the wrong medication, underscoring the importance of proper medication handling, labeling, and patient education to prevent such incidents.

Case report

An 11-year-old male patient presented with a 4-hour history of left eye pain and reduced vision. This occurred after his mother accidentally instilled teeth-whitening drops (DR. TS containing: Calcium Carbonate, Hydroxyl Cellulose, Sorbitol, Glycerin, Hydrated Silica, Sodium Sulfate, Hydroxypropyl-methylcellulose, Melaleuca Leaf Oil, Chromium Hydroxide Green, Tocopheryl Acetate, Honeysuckle Extract, Trisodium Phosphate, Menthol, Sodium Silicate, Titanium Dioxide) in that eye, instead of Betamethasone 0.1% and Neomycin 0.5% Probeta-N drops. Probeta-N had been prescribed a day before the incident, following complaints of eye pain in both eyes with no associated redness, swelling, or discharge.

Figure 1: Similarity between the dental whitening solution and the eye drops (Probeta-N). Both products come in small, white plastic bottles. Each has a similar dropper-style cap, which is typical for ophthalmic medication. Both have labels wrapped around the bottle, covering most of the surface. The rectangular label style with bold writing is visually similar. Both are compact bottles of comparable size. Cylindrical shape with narrow neck and screw cap looks identical at first glance. (© Aadil Bharadia)

The patient's mother reported that instillation of the drops was immediately followed by severe ocular pain, swelling, tearing, and redness. She acknowledged that the error occurred because the bottles appeared similar, leading to the accidental instillation. She subsequently realized the error upon noticing that she had used the dental whitening solution instead of the prescribed ophthalmic medication. The patient also had reduced vision in the affected eye. The mother immediately washed the eye with running tap water, and the patient reported a reduction in pain; however, vision remained impaired.

The patient was taken to a nearby health facility where irrigation was done, and eye drops were instilled (cyclopentolate, diclofenac, and gentamicin), then referred to Kenyatta National Hospital within 4 hours of the accident. At KNH, a short history was taken, and emergency management was done by irrigating with 2 liters of normal saline, the upper fornix was double everted and irrigated, and the lower fornix was also irrigated with normal saline.

Past ocular history, past medical history, and social history were non-remarkable. He had a family history of allergic conjunctivitis.

The clinical examination at consultation showed that he was in a fair general condition, but he was in pain. Visual acuity was 6/6 in his right eye and 6/18 in his left eye. Intraocular pressure for the right eye was 16mm/hg. Extraocular motility was free in both eyes.

The right eye had normal findings in both the anterior and posterior segments. For the left eye, the lids and lashes had moderate periorbital edema with mechanical ptosis and blepharospasms. The conjunctiva had chemosis more inferiorly. There was limbal ischemia from 10 o'clock to 2 o'clock. The cornea was very hazy with an epithelial defect measuring 10mm by 8.5mm, and anterior chamber details were difficult to assess. Iris details were also not clear, and the pupil was pharmacologically mid-dilated. The lens was difficult to assess, and it was not possible to see the fundus. The patient was admitted with an impression of left eye chemical injury, Roper Hall grade 3.

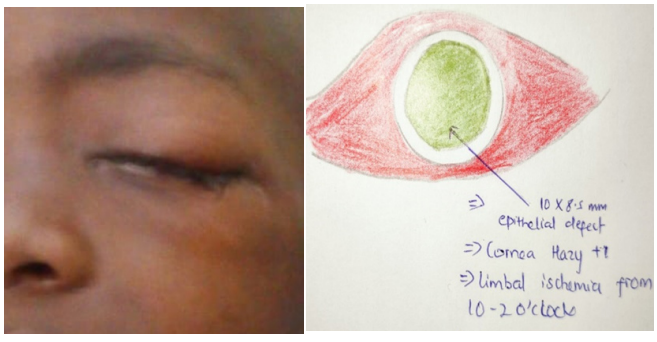

Figure 2: Affected eye (left) showing periorbital edema and corneal drawing showing total epithelial defect staining positive with Fluorescein, examined under blue filter. (© Aadil Bharadia)

After irrigation and examination, the patient was started on left eye moxifloxacin 0.5% eye drops 1 drop 4 times a day, cyclopentolate 1% 1 drop 3 times a day, prednisolone

acetate 1% 1 drop 2 hourly for a week, artificial tears 1 drop 4 times a day, and oral vitamin C 2g once a day for a week. A bandage contact lens was also prescribed and inserted.

On the fifth day of admission, the right eye had normal findings, and the left eye had improved. The patient had a vision of 6/9, intraocular pressures of 14mm/hg, there was mild periorbital edema with diffuse conjunctival injection, and the corneal epithelial defect had reduced in size to 5mm by 4.5mm. Patient was discharged home on the same medication to complete a week and then taper.

The patient was seen 1 week after discharge at the pediatric eye clinic, and on examination, his right eye had normal anterior and posterior segment findings, his left eye; vision was 6/9, and he had normal eyelids and eyelashes. The conjunctiva was injected from 6 o'clock to 9 o'clock, and limbal area reperfusion was noted. The cornea was clear, and the epithelial defect resolved. The anterior chamber and iris details were visible, and the bandage contact lens was removed. The pupil was pharmacologically dilated, and the lens was clear. The fundus was not examined. The patient was asked to stop cyclopentolate and prednisolone acetate, and to continue moxifloxacin 1 drop 4 times a day, artificial tears 1 drop 4 times a day, and vitamin C.

The patient was evaluated at the clinic after a three-week interval, during which both anterior and posterior ocular examinations were conducted. The vision in both eyes was 6/6, and the Intraocular pressures were 14 in the right eye and 15 in the left eye. The results for both eyes were within normal limits. The patient was advised to continue using artificial tears for an additional month and is scheduled to return to the clinic in one month for further evaluation and to look out for complications such as glaucoma, corneal scarring, limbal stem cell deficiency, and dry eye. Moreover, it is essential to monitor for any damage to the eyelids or conjunctiva that may result in scarring, symblepharon, entropion, or ectropion.

Discussion

The occurrence of eye medication mix-ups is frequently observed, yet these incidents often remain unreported and underrecognized within the community. The World Health Organization (WHO) has issued a safety alert regarding chlorhexidine, highlighting the emergence of multiple ocular injuries attributed to the use of this compound in nine sub-Saharan African countries. Chlorhexidine gluconate (CHX), which is available in both aqueous solution and gel form, is commonly utilized for umbilical cord care and is included in the WHO Essential Medicines List(20).

Ocular chemical injuries are emergencies requiring prompt management. The severity of these injuries depends on factors such as the chemical's acidity or alkalinity, dosage, and exposure duration(21).

Chemical eye injuries are classified as alkaline (pH > 7.0), acidic (pH < 7.0), and neutral. Alkaline injuries are more common and often result in more severe damage. In our case, the severe ocular burns were caused by a dental whitening product, which is primarily alkaline. Alkali agents, due to their lipophilic nature, penetrate tissues more rapidly than acids. They saponify the fatty acids in cell membranes, allowing them to infiltrate the corneal stroma and disrupt proteoglycan ground substance and collagen bundles. This tissue damage triggers the release of proteolytic enzymes, leading to further injury. This is known as liquefactive necrosis(19).

Despite the initial prognosis based on the characteristics of the substance, which was predominantly alkali and typically leads to more severe damage, the patient exhibited favorable outcomes. Several factors contributed to the mitigation of severe injury in this case: The chemical exposure was minimal, restricted to a single drop, which reduced the severity and depth of tissue damage(22,23). Prompt irrigation was initiated at the patient's home, continued upon presentation at the first hospital, and reinforced at Kenyatta National Hospital (KNH). Early and thorough irrigation is a critical determinant in minimizing chemical contact time and reducing tissue penetration(24,25). Treatment commenced at the first hospital before the patient was referred. Timely arrival at KNH, coupled with prompt and effective management as previously discussed and explained below, played a pivotal role in the patient's recovery(19,24–26).

The two main classification systems for chemical injuries are the Roper-Hall (modified Hughes) classification and the Dua classification (Table 1). The Roper-Hall classification is based on the extent of corneal involvement in conjunction with limbal ischemia. Conversely, the Dua classification evaluates limbal involvement measured in clock hours and the percentage of conjunctival involvement. These help predict the severity of the injury, determine the patient's prognosis, and guide treatment decisions(19).

Table 1: The Roper-Hall (modified Hughes) and the Duas classification(27) classification schemes for corneal burns.

Roper Hall Classification for Ocular Surface Burns			
Grade	**Prognosis**	**Cornea**	**Conjunctiva/Limbus**
I	Good	Cornea epithelial damage	No limbal ischaemia
II	Good	Cornea haze, iris details visible	<1/3-1/2 limbal ischaemia
III	Guarded	Total epithelial loss, stromal haze, iris details obscure	1/3-1/2 limbal ischaemia
IV	Poor	Cornea opaque, iris and pupil obscured	>1/2 limbal ischaemia

Dua Classification for Ocular Surface Burns				
Grade	**Prognosis**	**Clinical findings**	**Conjuctiva involvement**	**Analogue Scale***
I	Very good	0 clock hours of limbal involvement	0%	0/0%
II	Good	<3 clock hours of limbal involvement	<30%	0.1-3/1-29.9%
III	Good	3-6 clock hours of limbal involvement	30-50%	3.1-6/31-50%
IV	Good to guarded	Between 6-9 clock hours of limbal involvement	50-75%	6.1-9/31-50%
V	Guarded to poor	Between 9-12 clock hours of limbal involvement	75-100%	9.1-11.9/75.1-99%
VI	Very poor	Total limbus (12 clock hours) invloved	Total conjunctiva (100%) involved	12/100%

Irrigation is the cornerstone of its management. The goal of irrigation is to remove the offending substance and restore the physiologic pH(28,29). There is a wide variety of solutions available for irrigation. However, regardless of the type of irrigating fluid used, not delaying irrigation is paramount to limiting the duration of chemical exposure and thus minimizing ocular damage and restoring visual function(19,30).

The management following irrigation is categorized into two distinct approaches: medical therapy and surgical treatment. Medical therapy involves topical antibiotics to prevent superinfection, a cycloplegic agent to help with comfort and pain, and preservative-free lubricating eye drops for comfort and faster healing. Steroid eye drops are utilized to reduce inflammation, with initial intensive use prescribed during the first week. Subsequently, the dosage is tapered to prevent an imbalance in collagen metabolism, as prolonged exposure may lead to an increased rate of collagen breakdown rather than synthesis. Ascorbic acid is used in collagen synthesis, and doxycycline acts independently of its antimicrobial properties to reduce ocular surface inflammation(19,28,31).

Surgical treatment encompasses several procedures, including the debridement of necrotic tissue, tenonplasty, amniotic membrane transplantation, limbal stem cell transplantation, cultivated oral mucosal epithelial transplantation, and the Boston keratoprosthesis(19,28,31). Roper-Hall Grade 3 ocular chemical injuries typically carry a guarded prognosis and can significantly impair corneal healing and lead to long-term complications as discussed above. However, in the case of our patient, the clinical outcome was notably more favourable than generally expected for a Grade 3 injury. Several factors likely contributed to this improved prognosis: Limited Exposure, immediate Irrigation, early and appropriate Management, and efficient Referral and Continuity of Care.

Given these factors, our patient showed a significantly better response than typically anticipated for a Roper-Hall Grade 3 injury. This case underscores the importance of immediate first aid, early hospital intervention, and coordinated specialist care in altering the prognosis of moderate to severe ocular chemical injuries.

Equally important in this case is the aspect of prevention, which relies on both regulatory and public health measures. This case highlights the critical need for improved regulatory measures to minimize the risk of accidental ocular exposure to non-ophthalmic products packaged in dropper bottles. Drug regulatory authorities should provide clear guidance to pharmaceutical companies on differential packaging and dispensing practices for medicinal agents intended for different body parts. Strategies such as variations in container size, shape, and color can help reduce confusion,

allowing even individuals who cannot read to distinguish between commonly used products. Preventive strategies include the use of clear and standardized labeling, safe storage of chemical substances, keeping such products out of reach of children and the elderly, and avoiding the storage of non-ophthalmic substances alongside ophthalmic medications. Such interventions are particularly relevant in preventing incidents like the accidental instillation of dental whitening drops into the eye, as seen in this case(32,33).

Conclusion

Chemical ocular injury constitutes an ophthalmic emergency that necessitates prompt and effective management. Chemical eye injuries due to mistaken use of medications can lead to severe ocular damage, potentially resulting in long-term visual impairment. The primary factors influencing favorable outcomes in our patient included timely and adequate irrigation, the concentration of the caustic agent, and the early presentation to the healthcare facility.

This case highlights the importance of both timely clinical management and preventive public health measures. Patient education on chemical safety, proper labeling, safe storage away from children and the elderly, avoiding the placement of non-ophthalmic products alongside eye drops are essential, and careful verification before instilling medication. These are key strategies to reduce accidental instillation of non-ophthalmic products.

Ethical considerations

Patient particulars and facial appearance were not disclosed. Consent was obtained from the patient's mother, and assent was provided by the patient for the use of clinical photographs and for the publication of this case report.

References

1. Aronson JK. Medication errors: what they are, how they happen, and how to avoid them. QJM Mon J Assoc Physicians. 2009 Aug;102(8):513–21.
2. Emmerton LM, Rizk MFS. Look-alike and sound-alike medicines: risks and "solutions." Int J Clin Pharm. 2012 Feb;34(1):4–8.
3. Brown JA. Incorrectly dropped in the eye. Aust Prescr [Internet]. 2013 Apr 2 [cited 2025 Sep 14];36(2). Available from: https://australianprescriber.tg.org.au/articles/incorrectly-dropped-in-the-eye
4. Blackburn J, Levitan EB, MacLennan PA, Owsley C, McGwin G. The epidemiology of chemical eye injuries. Curr Eye Res. 2012 Sep;37(9):787–93.
5. Mauger T. Sodium hydroxide masquerading as a contact lens solution. Case report. Arch Ophthalmol Chic Ill 1960. 1988 Aug;106(8):1037.
6. Morgan SJ, Astbury NJ. Inadvertent self administration of superglue: a consumer hazard. Br Med J Clin Res Ed. 1984 Jul 28;289(6439):226–7.
7. Naunton M, Nor K, Bartholomaeus A, Thomas J, Kosari S. Case report of a medication error. Medicine (Baltimore). 2016 Jul 18;95(28):e4186.
8. NEEDHAM A, NATHA S, KAYE S. Similarities in the packaging of cyanoacrylate nail glue and ophthalmic preparations: an ongoing problem. Br J Ophthalmol. 2001 Apr;85(4):496–7.
9. Good AM, McCabe SE. Superglue accidents and the eye--causes and prevention. Br J Ophthalmol. 1994 Oct;78(10):802.
10. Jinagal J, Gupta PC, Gupta G, Sahu KK, Ram J. Ocular chemical burns from accidental exposure to topical dermatological medicinal agent. Indian J Ophthalmol. 2018 Oct;66(10):1476–7.
11. Parker RT, McCall DP, Samarawickrama C. Eye injury from toxic chemical mistaken for eye drops. Med J Aust. 2018 May 7;208(8):369.
12. 12. Tabatabaei SA, Modanloo S, Ghiyasvand AM, Pouryani A, Soleimani M, Tabatabaei SM, et al. Epidemiological aspects of ocular superglue injuries. Int J Ophthalmol. 2016 Feb 18;9(2):278–81.
13. Ling RT, Villalobos R, Latina M. Inadequacy of current labeling of nonophthalmic drops. N Engl J Med. 1989 Jan 5;320(1):62.
14. Singh S, Narang P, Mittal V. Oral mucosal grafting combined with tenonplasty for ocular surface and lid margin reconstruction in an atypical sectorial chemical burn. Case Rep. 2017 Aug 23;2017:bcr.
15. Clare G, Suleman H, Bunce C, Dua H. Amniotic membrane transplantation for acute ocular burns - Clare, G - 2012 | Cochrane Library. [cited 2025 Apr 13]; Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD009379.pub2/abstract
16. Wagoner MD. Chemical injuries of the eye: Current concepts in pathophysiology and therapy. Surv Ophthalmol. 1997 Jan 1;41(4):275–313.
17. Wagoner MD. Chemical injuries of the eye: current concepts in pathophysiology and therapy. Surv Ophthalmol. 1997;41(4):275–313.
18. Herr RD, White GL, Bernhisel K, Mamalis N, Swanson E. Clinical comparison of ocular irrigation fluids following chemical injury. Am J Emerg Med. 1991 May;9(3):228–31.
19. Chemical (Alkali and Acid) Injury of the Conjunctiva and Cornea - EyeWiki [Internet]. [cited 2025 Apr 13]. Available from: https://eyewiki.org/Chemical_(Alkali_and_Acid)_Injury_of_the_Conjunctiva_and_Cornea#cite_note-Wagoner-2
20. Chlorhexidine 7,1% digluconate (CHX) aqueous solution or gel (10ml): Reports of serious eye injury due to errors in administration [Internet]. [cited 2025 Apr 27]. Available from: https://www.who.int/news/

item/28-08-2020-chlorhexidine-7-1-digluconate-(chx)-aqueous-solution-or-gel-(10ml)-reports-of-serious-eye-injury-due-to-errors-in-administration
21. (PDF) Chemical injury to eye- A case report. ResearchGate [Internet]. 2024 Oct 22 [cited 2025 Apr 26]; Available from: https://www.researchgate.net/publication/358012644_Chemical_injury_to_eye-_A_case_report
22. Adepoju FG, Adeboye A, Adigun IA. Chemical Eye Injuries: Presentation and Management Difficulties. Ann Afr Med. 2007 Mar;6(1):7.
23. Baradaran-Rafii A, Eslani M, Haq Z, Shirzadeh E, Huvard MJ, Djalilian AR. Current and Upcoming Therapies for Ocular Surface Chemical Injuries. Ocul Surf. 2017 Jan;15(1):48–64.
24. Bizrah M, Yusuf A, Ahmad S. An update on chemical eye burns. Eye. 2019 Sep;33(9):1362–77.
25. Sharma N, Kaur M, Agarwal T, Sangwan VS, Vajpayee RB. Treatment of acute ocular chemical burns. Surv Ophthalmol. 2018;63(2):214–35.
26. 26. Singh P, Tyagi M, Kumar Y, Gupta KK, Sharma PD. Ocular chemical injuries and their management. Oman J Ophthalmol. 2013;6(2):83–6.
27. Eye News [Internet]. [cited 2025 Jun 25]. Periocular burns: a literature review of classification, management protocols and outcomes of treatment. Available from:https://www.eyenews.uk.com/features/ophthalmology/post/periocular-burns-a-literature-review-of-classification-management-protocols-and-outcomes-of-treatment
28. Singh P, Tyagi M, Kumar Y, Gupta KK, Sharma PD. Ocular chemical injuries and their management. Oman J Ophthalmol. 2013 May;6(2):83–6.
29. Kuckelkorn R, Schrage N, Keller G, Redbrake C. Emergency treatment of chemical and thermal eye burns. Acta Ophthalmol Scand. 2002 Feb;80(1):4–10.
30. Marsden J. How to perform irrigation of the eye. Nurs Stand R Coll Nurs G B 1987. 2016 Feb 3;30(23):36–9.
31. Baradaran-Rafii A, Eslani M, Haq Z, Shirzadeh E, Huvard MJ, Djalilian AR. Current and Upcoming Therapies for Ocular Surface Chemical Injuries. Ocul Surf. 2017 Jan;15(1):48–64.
32. American Pharmacists Association [Internet]. [cited 2025 Sep 17]. Prevent administration of ear drops into the eyes. Available from: http://www.pharmacist.com/Blogs/CEO-Blog/prevent-administration-of-ear-drops-into-the-eyes
33. Eye Medication Mix-Ups - American Academy of Ophthalmology [Internet]. [cited 2025 Sep 17]. Available from: https://www.aao.org/eye-health/glasses-contacts/eye-medication-mix-ups.