

Case Report

Thermal ocular and adnexal burn from a domestic wooden fire: a preventable cause of vision-threatening injury

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ABSTRACT

Thermal ocular injuries represent true ophthalmic emergencies that can result in significant morbidity if not managed promptly. Burns caused by domestic wooden fires, although uncommon, remain a preventable source of ocular trauma, particularly in rural or resource-limited environments where open-fire cooking is common. We report the case of a 38-year-old woman who sustained an accidental ocular and periocular thermal burn when her infant inadvertently struck her left eye with a burning wooden stick while she was cooking on a traditional chulha. On examination, she exhibited a partial-thickness burn of the lower eyelid and infraorbital skin, singeing of eyelashes, and deposition of carbon particles within the inferior conjunctival fornix. The cornea showed a 4 × 3 mm epithelial defect with fluorescein uptake but without stromal involvement. Immediate and copious irrigation, followed by mechanical removal of carbon debris and initiation of topical antibiotic-steroid therapy with lubricants, led to rapid improvement. By the three-week follow-up, the patient achieved complete epithelial healing, resolution of inflammation, and restoration of 6/6 visual acuity, without cicatricial or corneal complications. This case underscores that ocular and adnexal burns from domestic wooden fires are rare yet entirely preventable. Early recognition, prompt irrigation, and meticulous debridement are crucial to preventing vision-threatening sequelae. Increased public awareness, patient education, and fire safety measures remain essential to reducing the burden of preventable domestic ocular injuries.

Keywords: Ocular burn, Thermal injury, Adnexal burn, Wooden fire, Corneal epithelial defect, Ocular trauma, Preventive ophthalmology

INTRODUCTION

Thermal ocular injuries are ophthalmic emergencies that can cause significant morbidity if not managed promptly and appropriately. They account for approximately 7–10% of all ocular trauma cases and may result in a spectrum of damage, ranging from mild conjunctival hyperemia to full-thickness corneal necrosis and eyelid contracture, depending on the source, temperature, and duration of exposure.^{1,2} While chemical burns are more frequently reported, thermal burns due to flames, molten metal, or

steam are relatively uncommon but can lead to equally devastating outcomes.³ Among these, domestic fire-related ocular burns represent a preventable category of injury that continues to occur, especially in low- and middle-income settings where open cooking fires remain prevalent.^{4,5} The adnexal structures, including the eyelids, lashes, and periocular skin, play a critical protective role during such thermal insults. Reflex eyelid closure and blink response typically limit direct ocular damage, confining injury predominantly to the periorbital tissues.⁶ However, retained particulate matter such as carbon or ash from wooden fires can lodge in the conjunctival fornices,

perpetuating inflammation, secondary infection, and potential granuloma formation if not meticulously removed.^{7,8} This report describes a case of ocular and adnexal burn resulting from a domestic wooden fire, highlighting the clinical presentation, prompt management, and favorable recovery. The case underscores the importance of early irrigation, foreign body clearance, and conservative therapy in preventing sight-threatening sequelae.

CASE REPORT

A 38-year-old woman presented to the emergency ophthalmology department with a thermal injury to the left eye and adnexa. The injury occurred while she was cooking on a traditional *chulha* (wood-fired stove). During the process, her infant, who was nearby, accidentally inserted a piece of burning wood, striking her left eye and periocular region. The patient immediately experienced severe burning pain, excessive tearing, redness, and inability to open the affected eye.

Superficial burn changes are visible over the central upper eyelid, extending up to the eyelid crease, with singeing of eyelashes noted on both upper and lower lids. The lower eyelid shows mild crusting and localized tissue contraction following thermal exposure from a domestic wooden fire.

On presentation, the patient's best-corrected visual acuity (BCVA) was 6/6 in the right eye and 6/36 in the left eye. The affected eye exhibited diffuse periorbital erythema and edema. Examination of the adnexa revealed a partial-thickness thermal burn involving the left lower eyelid and adjacent infraorbital skin, characterized by erythema, crusting, and focal epithelial loss (Figure 1).



Figure 1: Clinical photograph of the left periocular region showing a partial-thickness thermal burn involving the infraorbital skin with erythema, oedema, and focal epithelial loss.

The lower eyelashes were singed, with partial loss of cilia along the lid margin. Mild lid edema and tenderness were present; however, there was no evidence of cicatricial contracture or lagophthalmos. The conjunctiva was

markedly hyperaemic and chemotic, with numerous carbonaceous particles and ash debris adherent to the inferior conjunctival fornix and palpebral conjunctiva, consistent with soot and coal deposition from the wooden fire (Figure 2).



Figure 2: Slit-lamp photograph of the left eye showing deposition of fine carbonaceous particles and soot within the inferior conjunctival fornix and palpebral conjunctiva.

These particles were carefully removed under topical anaesthesia using sterile cotton-tipped applicators and placed on saline wet gauge piece as shown in (figure 3) A and B. Slit-lamp bio microscopy revealed a diffuse corneal epithelial haze and an inferior epithelial defect measuring approximately 4×3 mm, which demonstrated positive fluorescein staining. The corneal stroma was clear, with no signs of infiltration or thinning. The anterior chamber was quiet, and the pupil was round and reactive to light. Intraocular pressure was within normal limits. Examination of the contralateral (right) eye was unremarkable, with no signs of injury or inflammation.

Management and follow-up

Immediate management involved copious irrigation of the affected eye with sterile normal saline for 20 minutes to eliminate residual heat and surface contaminants. After thorough irrigation, mechanical removal of retained carbonaceous particles was carefully performed under aseptic precautions using sterile cotton-tipped applicators. Once the ocular surface was cleared of debris, the patient was started on a comprehensive medical regimen. Topical broad-spectrum antibiotic-steroid combination drops (tobramycin–lotepednol, four times daily) were prescribed to prevent secondary infection and reduce inflammation. A lubricating gel containing carboxymethylcellulose was applied four times daily to maintain ocular surface hydration and support epithelial healing. For symptomatic relief and to minimize ciliary spasm, a topical cycloplegic agent, homatropine 2%, was administered twice daily.

Systemic therapy included oral non-steroidal anti-inflammatory drugs (NSAIDs) for pain control and oral antibiotics (amoxicillin–clavulanate 625 mg thrice daily for five days) as prophylaxis against infection. The patient was advised to avoid eye rubbing, apply cold compresses for comfort, and follow up regularly for monitoring of healing progress. At subsequent reviews, the ocular surface showed progressive improvement, with significant reduction in inflammation and complete epithelial regeneration.

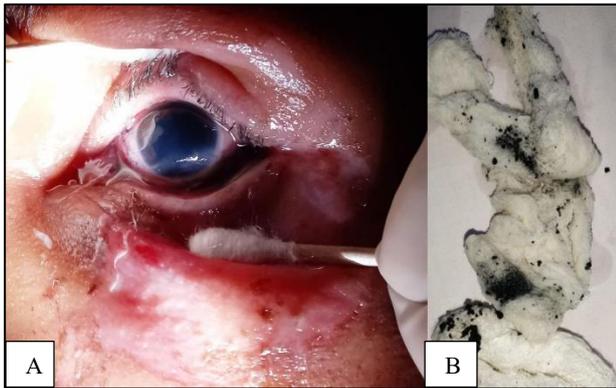


Figure 3: (A) magnified clinical image showing charred debris and loss of upper and lower eyelid eyelashes with pronounced conjunctival hyperaemia. A superficial thermal burn involving the lower eyelid skin measuring approximately 10×8 mm is visible, with retained carbon particles adherent along the inferior lid margin and bulbar conjunctiva and (B) removed carbonaceous particles of varying sizes collected and displayed on moist sterile cotton gauze following meticulous debridement under topical anaesthesia.

Focal inferior limbal ischaemic changes persist, accompanied by marked conjunctival chemosis and congestion. A few fine soot particles remain entrapped within the conjunctival tissue. The eyelid margin and eyelashes exhibit burn changes with mild peril-limbal tissue contraction, consistent with resolving thermal injury from a domestic wooden fire.

At the two-day follow-up, the patient demonstrated rapid improvement in ocular surface healing, with a marked reduction in pain and redness. Slit-lamp examination revealed early epithelial regeneration of the corneal defect, with only a few residual areas of fluorescein dye uptake. Focal inferior limbal ischemic changes with persistent conjunctival chemosis and congestion were still noted. A few fine soot particles remained entrapped within the conjunctival tissue, while the eyelid margin and eyelashes exhibited mild burn-related changes and peri-limbal tissue contraction during the healing phase (Figure 4). Cold compresses were advised to reduce inflammation, and the patient was instructed to avoid rubbing the eye. At the one-week follow-up, there was marked clinical improvement. The periocular erythema and edema had subsided

significantly, and re-epithelialization of the infraorbital skin was nearly complete and BCVA improved to 6/12 in both eyes (Figure 4). At three weeks follow-up the corneal epithelial defect had healed completely, with restoration of normal transparency and no residual haze. Conjunctival hyperaemia and chemosis had resolved, and BCVA improved to 6/6 in both eyes. No late sequelae such as symblepharon, cicatricial lid changes, or corneal scarring were observed during follow-up.

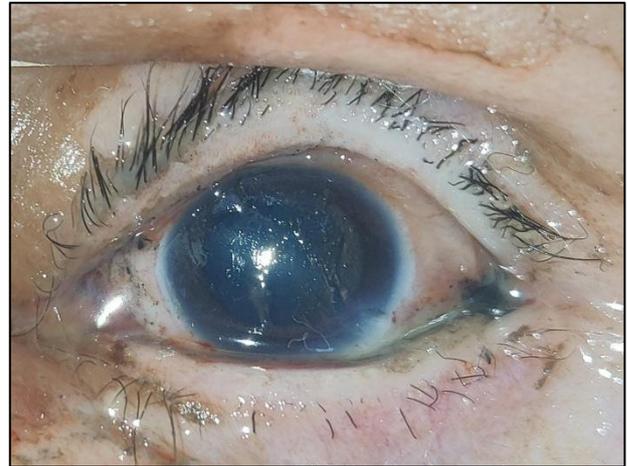


Figure 4: Slit-lamp photograph obtained on day 2 follow-up demonstrating rapid healing of the corneal epithelial defect, with few residual areas showing fluorescein dye uptake.

Clinical impression

This case was diagnosed as a thermal ocular and adnexal burn secondary to domestic wooden fire exposure, involving partial-thickness skin injury and a superficial corneal epithelial defect, which resolved completely with prompt and appropriate conservative management.

DISCUSSION

Thermal burns of the eye are ophthalmic emergencies that demand immediate recognition and prompt management to minimize long-term morbidity. Although chemical burns are more frequently encountered in clinical practice, thermal ocular burns are relatively uncommon, accounting for only 4–10% of ocular trauma cases.¹ These injuries usually result from exposure to flames, molten metal, or steam, with domestic fire accidents being an increasingly recognized cause in low-resource environments where open-fire cooking remains prevalent.²⁻⁵ In the present case, the mechanism of injury involved direct contact of burning wood from a household chulha with the patient's periocular region. The eyelids and lashes serve as the first line of defense against such thermal insults. Reflex closure of the eyelids typically protects the cornea and globe, resulting in injury primarily confined to the adnexa and conjunctiva.⁶ This natural protective mechanism likely limited the extent of ocular surface damage in our patient. The severity of ocular burns depends on several factors,

including the temperature of the heat source, duration of exposure, and presence of particulate debris.³

In our case, carbonaceous particles and ash fragments were embedded in the inferior conjunctival fornix, producing persistent inflammation and posing a risk for granuloma formation if not removed promptly. Thorough ocular surface irrigation and mechanical debridement under topical anaesthesia remains the cornerstone of initial management.⁷ Early irrigation serves multiple purposes: it removes residual heat, flushes out particulate matter, and prevents secondary chemical effects caused by alkaline or acidic residues from combustion products.⁴ Following surface decontamination, topical broad-spectrum antibiotics reduce the risk of infection, while steroids help suppress inflammation and limit cicatricial sequelae.⁸ Lubricants and cycloplegics aid in epithelial regeneration and symptomatic relief.⁹ The corneal epithelial defect observed in this patient healed rapidly due to prompt therapy and the absence of stromal involvement.

Previous reports emphasize that superficial corneal burns typically have an excellent prognosis when treated early, whereas deep stromal burns or limbal ischemia can lead to devastating complications such as corneal melt or symblepharon formation.^{10,11} This case also underscores the importance of public awareness and preventive measures. In rural and semi-urban communities, injuries from domestic fires are often underreported. Promoting safe cooking practices and child supervision near open flames can significantly reduce preventable ocular injuries.¹²

However, severe thermal injuries involving the limbus or corneal stroma can cause limbal stem cell deficiency (LSCD), conjunctivalization, and scarring, leading to permanent visual loss.¹³ Advances in ocular surface reconstruction techniques such as Simple Limbal Epithelial Transplantation (SLET) and amniotic membrane grafting have significantly improved visual outcomes in these advanced cases.^{14,15} Nevertheless, the need for early referral and intervention remains paramount. This case also highlights a public health dimension. In many rural Indian households, traditional biomass stoves (chulha) remain a primary cooking method. Women, often cooking with infants nearby, face an increased risk of flame-related ocular trauma.

Recent epidemiological studies emphasize that over one-third of domestic ocular burns in India and Southeast Asia are preventable through basic fire safety education and child supervision.^{16,17} Public health initiatives promoting smokeless stoves and safer cooking practices can therefore play a pivotal role in reducing these avoidable injuries. In conclusion, thermal ocular burns from wooden fires, though rare, are entirely preventable. Early irrigation, meticulous removal of debris, and timely initiation of topical therapy are critical to preventing sight-threatening complications. The favourable outcome in this case underscores the importance of rapid intervention, patient

education, and awareness of domestic ocular burn hazards. Strengthening preventive strategies and ensuring access to prompt ophthalmic care remain essential to preserving vision in such accidental injuries.

Overall, this case reinforces established management principles: early irrigation, meticulous debris removal, topical anti-inflammatory and antibiotic therapy, and vigilant follow-up. With timely intervention, even thermal burns involving both adnexal and ocular tissues can achieve complete anatomical and visual recovery.

CONCLUSION

Thermal ocular burns resulting from domestic wooden fires are rare but entirely preventable causes of ocular morbidity, particularly in low-resource and rural environments. This case underscores the protective role of the adnexa, the importance of early irrigation and meticulous debridement, and the effectiveness of prompt topical therapy in achieving full anatomical and visual recovery. A high index of suspicion, immediate ophthalmic evaluation, and timely intervention are pivotal in preventing complications such as infection, cicatricial changes, or limbal stem cell deficiency. Public health measures promoting safe cooking practices and awareness about ocular first aid especially in communities using open-fire stoves can significantly reduce the incidence of such injuries. Ultimately, this report reinforces that even minor-appearing thermal burns to the ocular surface warrant urgent, evidence-based management to preserve sight and prevent avoidable blindness.

Patient consent and ethics statement

Written informed consent was obtained from the patient for publication of this case report and the accompanying clinical images. The patient was assured of anonymity, and all identifying details have been omitted to protect confidentiality. This report was conducted in accordance with the Declaration of Helsinki (2013 revision) and institutional ethical standards. Ethical approval was not required for this single-patient case report, as per the policy of Dr. KNS Memorial Institute of Medical Sciences, Barabanki, Uttar Pradesh, India, since no experimental intervention or deviation from standard clinical care was involved.

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