*Clinical & Refractive Optometry* is pleased to present this continuing education (CE) article by Dr. Ron Melton and Dr. Randall Thomas entitled **Thermal or Ultraviolet Burns.** In order to obtain a 1-hour Council of Optometric Practitioner Education (COPE) approved CE credit, please refer to page 224 for complete instructions.

## Thermal or Ultraviolet Burns

*Ron Melton, OD; Randall Thomas, OD*

### SUBJECTIVE

A 44-year-old Caucasian female presented with a history of burning her right eye with a curling iron. This happened earlier in the morning while she was getting ready for work. Immediately after the accident she had rushed to the emergency room, where she had received a shot of pethidine hydrochloride (Demerol)/promethazine hydrochloride (Phenergan) for the pain associated with her corneal injury. She was then sent by the ER for further ocular evaluation and treatment.

### OBJECTIVE

- Visual acuity (VA): OD 6/15 (20/50) (pinholed no improvement); OS 6/7.5 (20/25) (pinholed no improvement)
- Gross observation: normal OU
- Pupils: OD slightly miotic compared to the OS pupil
- Lids: uninvolved OU
- Conjunctiva: mild injection OD
- Cornea: OD shows deep necrotic epithelial thermal burn to two-thirds of the cornea superiorly (Fig. 1)
- Anterior chamber: clear with no cells/flare OU
- Tension by applanation: 17/16 mm Hg at 8:30 a.m.
- Internal: 0.2 cup-to-disc OU with maculae and retinal blood vasculature normal OU

### ASSESSMENT

- Thermal keratopathy OD

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### PLAN

- In-office debridement of necrotic corneal epithelium was done. About 80% of the way through the procedure the patient experienced a vasovagal episode. An ammonia inhalant capsule was used to revive her, and the remainder of the debridement procedure was aborted (Fig. 2)
- OD was cyclopleged in-office with homatropine 5%. A drop of diclofenac sodium (Voltaren), and erythromycin ophthalmic ointment, were instilled. A pressure patch was applied.
- The patient indicated that she had taken acetaminophen/hydrocodone earlier for her pain. She was given a prescription for 5 mg hydrocodone bitartrate/500 mg acetaminophen, 1 tablet q.6h. p.o. as needed for pain x 10 tablets.

*Follow-up Day 1*

- The patient was still in considerable discomfort, but she indicated that she was feeling less nauseated than the day before. The VA in the involved OD was 6/12 (20/40). The pupil remained dilated from the homatropine that had been instilled the day before. There was approximately a 60% re-epithelialization of the corneal defect.
- The patient was given a prescription for moxifloxacin (Vigamox) 1 drop q.i.d. OD, to be alternated with diclofenac sodium 1 drop q.i.d. OD. She was told to continue taking her 5 mg hydrocodone bitartrate/500 mg acetaminophen for pain, as needed, according to the previous instructions.

*Follow-up Day 2*

- The patient's pain had subsided to the point where she had discontinued the 5 mg hydrocodone bitartrate/500 mg acetaminophen. Her VA was 6/7.5 (20/25) OD. The pupil remained dilated, although it was starting to show signs of reaction. A slit-lamp exam showed almost complete resolution of the corneal defect (Fig. 3). There was a linear area of negative fluorescein uptake at the site where the epithelial cells were coming together. The anterior chamber remained quiet. The patient cracked her first smile in two days.

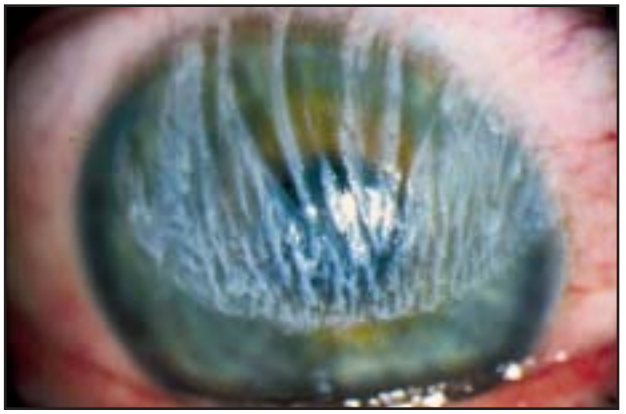

Fig. 1 There was extensive necrotic epithelial tissue secondary to the thermal energy from a curling iron insult.

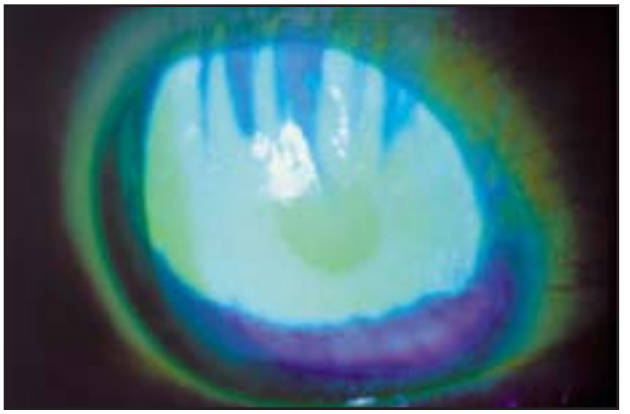

Fig. 2 Fluorescein uptake superiorly to the debrided area was interrupted secondary to the patient undergoing a vasovagal episode.

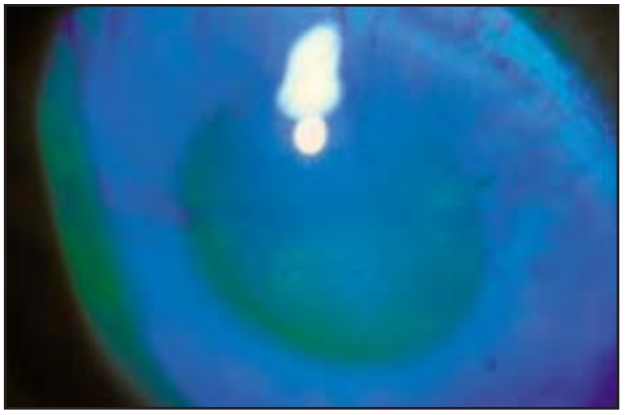

Fig. 3 Two days after the initial thermal keratopathy the epithelium was almost completely healed.

- The patient was instructed to continue the moxifloxacin 1 drop b.i.d. OD x 3 days, then discontinue it. The diclofenac sodium was to be stopped after one more day. It was recommended that she use non-toxic artificial tears during the day and GenTeal gel at bedtime for the next few weeks. The patient was to be rechecked in 2 weeks for a follow-up of the corneal injury; a complete eye examination was to be done then, as it had been 4 years since her last comprehensive eye evaluation.

*Comments*: This patient had a classic thermal corneal burn — in this case, it was caused by a curling iron. Other common causes of ocular damage that is induced by thermal energy or ultraviolet radiation include cigarettes, hot metal, welding arcs, and sunlamps.

Clinical symptoms and signs vary greatly in thermal/ultraviolet keratopathy. Most patients present with moderate-to-severe pain, redness, photophobia, tearing, and a foreign-body sensation. With welder's flash or sun lamp injuries, the degree of pain generally does not correlate with the extent of corneal damage. Patients often present with a mild confluent superficial punctate keratitis, yet they may complain of moderate-to-severe pain. In-office cycloplegia, nonsteroidal drops, and an oral pain medication (e.g., acetaminophen with or without codeine or hydrocodone) may help. Naproxen (Naproxyn) or tramadol (Ultram) are alternatives to the narcotic analgesics for ocular pain relief.

The degree of corneal necrosis helps the clinician determine if debridement of the damaged tissue is warranted. The damage to the epithelium may not be as deep, resulting in less necrosis but more of an inflammatory response. In this situation, debridement is usually not necessary and these patients may benefit from a combination antibiotic-steroid drop (Figs. 4-6).

The patient in Figure 1 experienced damage to her corneal epithelium, with resulting deep necrotic tissue. In this case, the necrotic tissue was debrided after a drop of proparacaine 0.5% was instilled. Debridement was aborted once the patient underwent a vasovagal episode, although by this time 80% to 90% of the necrotic tissue had been removed. It is important to have some ammonia capsules in the office for those patients who are predisposed to vasovagal response (Fig. 7).

After the excitement created by the vasovagal episode, the patient's right eye was cyclopleged to relax the iris muscle in order to decrease pain and prevent secondary iritis. The debrided corneal defect now has to be treated and there are several ways to accomplish this. It was decided to pressure patch the eye because of the size of the corneal defect and because of the amount of

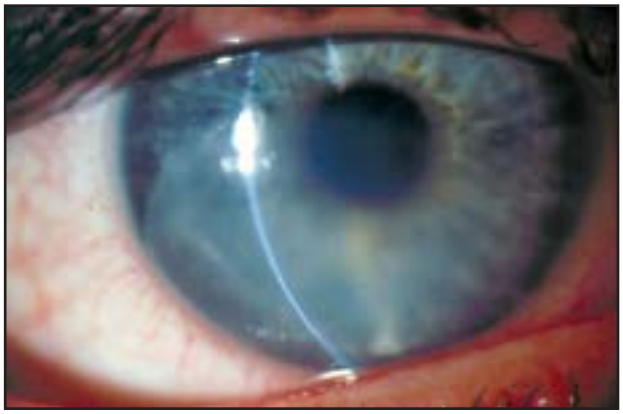

Fig. 4 This curling iron injury resulted in less deep necrosis to the ocular surface and more inflammation to the epithelium.

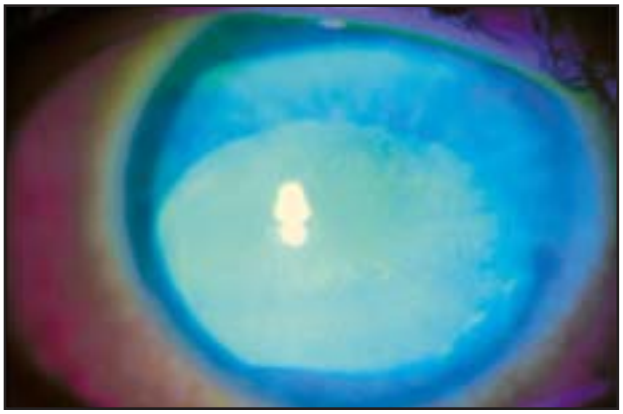

Fig. 5 There was fluorescein update to the area of injury from this curling iron injury.

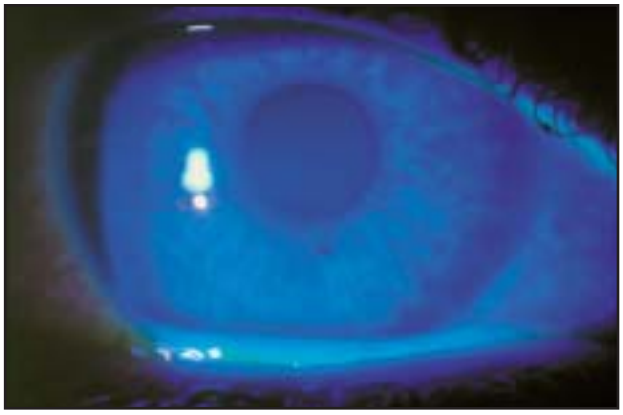

Fig. 6 The addition of a combination antibiotic/steroid drop resulted in complete healing to the inflamed corneal epithelium (seen in Fig. 5).


Fig. 7 Ammonia capsules are important to have available in the office for patients who may have a vasovagal response.

photophobia and pain presented by the patient. A drop of diclofenac sodium before the eye is patched should help to retard some of the pain. The erythromycin ophthalmic ointment is a good non-toxic broad spectrum antibiotic to use when the insult to the cornea is secondary to a relatively clean source. When the eye is pressure-patched, there is an obligation to follow-up the patient within 24 hours. This patient was showing improvement to the corneal defect and fewer symptoms. Therefore, a good prophylactic antibiotic drop (Vigamox) and a nonsteroidal anti-inflammatory (NSAID) drop (Voltaren), were prescribed, and the patient was followed in 1 day. At that time the epithelium had made a remarkable improvement.

The prognosis for this curling iron thermal keratopathy is good, with complete recovery of visual function and ocular surface integrity. Most of the thermal/ultraviolet keratitis injuries heal rapidly and without visual compromise.

## General Observations

- Excessive thermal or infrared energy can result in significant damage to eyelids or globe

### Etiology

- Curling irons, tobacco ash, molten metal, a history of welding or using a sun lamp without eye protection are some of the more common causes of thermal injuries to the eye or lid

### Symptoms

(These depend on the severity of the thermal injury)

- Burning with aching pain
- Reduced acuity
- Photophobia, lacrimation, foreign-body sensation

### Clinical Signs

- Epithelial loss
- Epithelial/stromal edema

- Hyperemia/chemosis to eyelids and/or eye
- Possible anterior uveitis

**Burn Classification**
- 1st degree: swollen skin and redness
- 2nd degree: blisters on skin
- 3rd degree: charring of deep layers

**Diagnosis**
- Degree of facial and eyelid burns should be established
- Extent of conjunctival and corneal injury assessed with fluorescein

**Treatment**
- Debridement of deeper necrotic corneal epithelium
- Cycloplegic [in-office cyclopentolate hydrochloride (Cyclogyl 1%) or homatropine 5%, depending on extent of corneal involvement]
- Mild/moderate burns: prophylactic antibiotic drops and NSAID drops for pain until epithelium healed; antibiotic/steroid drops may be used instead if corneal involvement is mild
- Moderate/severe burns: bandage lens or pressure patching may be considered
- If severe eyelid burn, do not patch
- Oral pain medication (ASA/acetaminophen, with or without codeine or hydrocodone; options to the narcotics are naproxen or tramadol)
- Follow-up is based on the severity and degree of corneal involvement

***Disclaimer**: Not every detail of every case is discussed, rather the key clinical findings are described. For example, if nothing is said about the corneal status, you should assume that the cornea is normal, etc. When vision is recorded, it should be assumed to be best corrected or pinholed. Regarding therapy, we show how we treated the particular case. Given that medicine is an art, as well as a science, therapy will — and often does — vary with each unique patient presentation depending on severity, known drug allergies, prior treatment, response to therapy, etc.*

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## QUESTIONNAIRE

### Thermal or Ultraviolet Burns

*Ron Melton, OD; Randall Thomas, OD*

1. In the case presented, which one of the following statements is **FALSE**?
   - ❑ Objective examination revealed OD pupil slightly miotic compared to OS pupil
   - ❑ OD deep necrotic epithelial thermal burn to cornea superiorly
   - ❑ Visual acuity OD 6/15 (20/50)
   - ❑ Internal: retinal blood vasculature abnormal OU

2. The treatment plan included all of the following **EXCEPT**:
   - ❑ In-office debridement of necrotic corneal epithelium was done
   - ❑ OD was cyclopleged in-office with homatropine 10%
   - ❑ The patient was given a prescription for 5 mg hydrocodone bitartrate/500 mg acetaminophen
   - ❑ Erythromycin ophthalmic ointment was instilled in-office

3. Which of the following statements is **TRUE**?
   - ❑ At follow-up Day 1, the VA in the involved OD was 6/12 (20/50)
   - ❑ At follow-up Day 2, the patient had discontinued the 200 mg acetaminophen
   - ❑ Non-toxic artificial tears during the day was recommended to the patient
   - ❑ At follow-up Day 2, the patient was instructed to continue moxifloxacin 1 drop b.i.d OD x 2 days

4. Patients with thermal or ultraviolet burns typically present with:
   - ❑ Redness
   - ❑ Photophobia
   - ❑ A foreign-body sensation
   - ❑ All of the above

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5. Common causes of corneal burns are:
   - ❑ Hot metal
   - ❑ Welding arcs
   - ❑ Cigarettes
   - ❑ All of the above

6. Which of the following was **NOT** part of the patient's treatment plan?
   - ❑ Penicillin
   - ❑ Hydrocodone bitartrate
   - ❑ Diclofenac sodium
   - ❑ Moxifloxacin drops

7. In cases of thermal or ultraviolet burns, which of the following statements is **FALSE**?
   - ❑ Clinical signs and symptoms vary greatly
   - ❑ In-office cycloplegia and nonsteroidal drops may help relieve symptoms
   - ❑ The degree of pain always correlates with the extent of corneal damage
   - ❑ Patients often present with a mild confluent superficial punctate keratitis

8. Which one of the following statements is **FALSE**?
   - ❑ In cases of corneal burn, secondary iritis may ensue
   - ❑ Pressure patches do not necessarily require follow-up visits
   - ❑ Vigamox is a good prophylactic antibiotic drop
   - ❑ Ammonia capsules should be on hand in the event of vasovagal response

9. Which of the following are clinical signs of corneal burn?
   - ❑ Hyperemia/chemosis to eyelids and/or eye
   - ❑ Epithelial/stromal edema
   - ❑ Epithelial loss
   - ❑ All of the above

10. All of the following statements are true, **EXCEPT**:
    - ❑ 1st degree burns involve skin blisters
    - ❑ Extent of conjunctival and corneal injury should be assessed with fluorescein
    - ❑ Severe eyelid burns should not be patched
    - ❑ In this case, extensive necrotic epithelial tissue resulted from the thermal energy burn