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**Case Report**

# Electric burns: a unique pattern of ocular injuries

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## ABSTRACT

Burn injuries are a global health issue affecting millions of people annually, more so in developing countries. Electric burns are severe and uncommon forms of burn injuries which account for approximately less than 5% of all burn injuries, and are associated with high morbidity and mortality. Ocular complications occur in approximately 5% of electric burn cases, and they often present in unique patterns depending on the path of the electrical current. This case report describes a 35-year-old man who sustained high-voltage electric burns following an alleged cable theft incident. He suffered burns to his face, neck, left upper limb, and bilateral lower limbs, with subsequent ocular injuries that included exposure keratopathy, corneal perforation, and eyelid necrosis. His management entailed multiple surgical interventions, moisture chambers, tarsorrhaphy, and an amnion corneal transplant. This case highlights the importance of early ophthalmologic assessment and intervention to prevent severe vision loss. Given the devastating effects of electric burns, public awareness and preventive measures remain crucial.

**Keywords:** Electrical burns, Ocular injuries, High-voltage trauma, Corneal perforation, Ophthalmological management

## INTRODUCTION

Electrical burn injuries, although less common than other types of burns, are associated with significant morbidity and mortality.[1] These injuries can result from exposure to either low voltage (<1000 volts) or high voltage (>1000 volts) currents, with high-voltage injuries leading to severe tissue destruction, multi-organ involvement, prolonged hospital stays and even death.[2,3,5]

Among the various complications, ocular injuries, although rare, occur in approximately 5% of electric burn cases, and they can have devastating consequences, including permanent visual impairment.[4]

Ocular injuries in electrical burns are thought to occur through four main mechanisms: direct electrical injury to the optic nerve and ocular structures, thermal injury from heat generated by electrical energy conversion, tissue ischemia as a result of cardiac injury or vasoconstriction, and secondary mechanical trauma due to falls.[6-8] These injuries can be asymmetrical, depending on the path of the current.[7] Common manifestations include interstitial opacifications, exposure keratopathy, conjunctival chemosis, and eyelid defects, which can lead to permanent vision loss if not promptly managed.[7]

This case report presents a 35-year-old man with extensive high-voltage electrical burns, including a unique pattern of ocular injuries. His injuries highlight the severity of electric burns and the importance of early ophthalmological intervention and specialized management to prevent long-term complications and optimize outcomes.

## CASE REPORT

On the 07 December 2023, a 35-year-old man was brought to Charlotte Maxeke Johannesburg Academic Hospital by Emergency Medical Services (EMS). He was found inside a substation during an alleged cable theft, sustaining electric burns to his face, neck, left upper limb and bilateral lower limbs.

On arrival to the emergency department, he was assessed and managed according to the advanced trauma life support (ATLS®) principles. He presented with low Glasgow coma scale (GCS) of 8/15, and airway oedema was noted during intubation. He had a blood pressure of 145/84 mmHg, pulse of 70 beats per minute, respiratory rate of 20 breaths per minute, temperature of 36 °C and a saturation of 92% on $FiO_2$ of 80%. On further systemic examination, he had good bilateral air entry and was haemodynamically stable.

He had 20% total body surface area burns: 4.5% deep partial thickness burns to the face with full thickness burns to the neck, 9% full thickness circumferential burns to the left upper limb, with tense compartments and no palpable radial pulse and a further 6.5% deep partial thickness burns to both lower limbs.

An electrocardiogram (ECG) showed ST segment elevations on leads V4-V6 and laboratory findings included a creatinine kinase of more than 20000 U/l, a normal renal profile, and a troponin T of 23 ng/l.

The patient was resuscitated using the modified Parklands formula and he received an anti-tetanus toxoid injection and analgesia. His wounds were scrubbed and an escharotomy of the left upper limb was done. He was subsequently taken to theatre for an above-elbow amputation as the left limb was non-viable. While in theatre, the neck burns wounds were also debrided and the facial burns were scrubbed. He was transferred to the ward post-operatively and was extubated the following day.

He was taken back to theatre for amputation of the 1st and 2nd right toes as they were noted to be necrotic during his review, his left arm stump was also debrided. Intra-operatively, the plastic surgery team was consulted for the necrotic areas on his nose, lips and left side of the neck. Upon closer inspection, it was noted that he had bilateral exposed cornea with burns to the left eye and bilateral chemosis. An ophthalmology consult was requested post-operatively, and in the meantime, occlusive dressings of chloromax and opsite were used.

Ophthalmological examination revealed deep partial thickness burns to the face and eyelids that led to bilateral exposure keratopathy, secondary to lagophthalmos from wound contraction in the upper eyelids. Despite these injuries, he still retained partial vision in both eyes. The left cornea had severe thinning and was complicated by a corneal perforation (Figure 1). A corneal scrape on the left eye was done and infective keratitis was excluded. No other sequelae of ocular electric injuries were identified. The initial management by ophthalmology included bilateral moisture chambers to maintain corneal hydration and a left sliding tarsorrhaphy to reduce corneal exposure (Figure 2).

**Figure 1: Day 10 post injury. Bilateral deep partial thickness burns to the eyelids. More extensive lagophthalmos on the left with prominent corneal exposure.**

**Figure 2: Sliding tarsorrhaphy in the left eye.**

The patient was subsequently taken back to theatre, where the plastic surgery team re-debrided the nose, lips, left neck and part of the face and the Ophthalmology team debrided the necrotic tissues of the eyelids and a repeat tarsorrhaphy of the left eyelid was performed (Figure 3). Topical antibiotics, lubrication and moisture chambers were continued in both eyes. The face and neck were dressed with Melladerm and Jelonet dressings on alternate days.

A multi-layered amnion corneal transplant was performed on the left eye and covered with an amnion membrane graft to protect the exposed cornea (Figures 5 and 6).

**Figure 3: Day 1 post facial and eyelid debridement. Repeat tarsorrhaphy on the left eye was performed but eventually dislodged due to necrosis and surrounding tissue loss.**

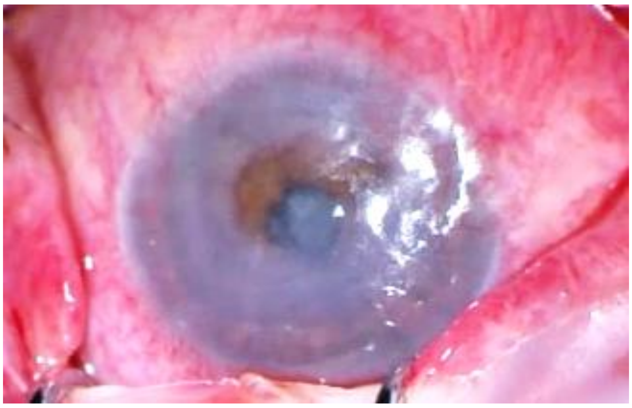

**Figure 4: Oedematous cornea surrounding thin, leaking central cornea.**

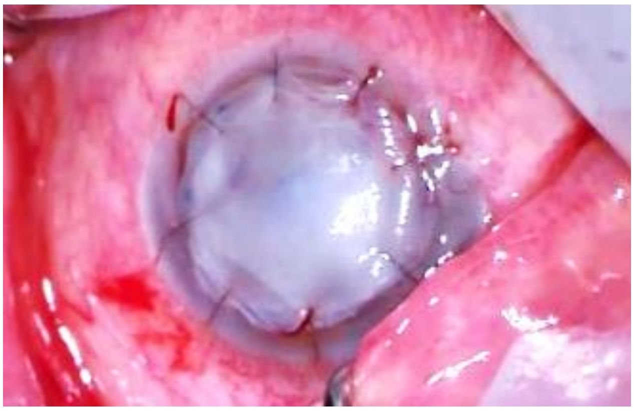

**Figure 5: Intraoperative image revealing layered amniotic corneal inlay graft.**

The right eyelid was fully granulated, and the exposure keratopathy resolved with a vision of 6/60. The left eye, however, had a significant central full-thickness eyelid defect (Figure 7). The surrounding granulation tissue was too friable to perform a primary lid repair, and the patient was managed with moisture chambers.

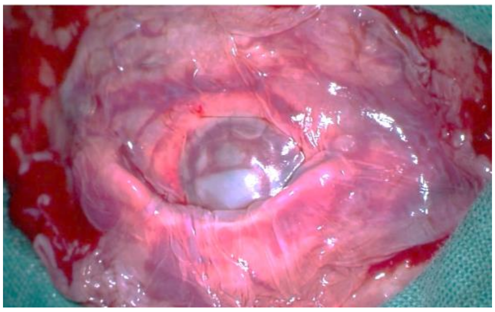

**Figure 6: Intraoperative image displaying amniotic membrane transplant fixed to the conjunctiva after completing the layered amniotic inlay graft.**

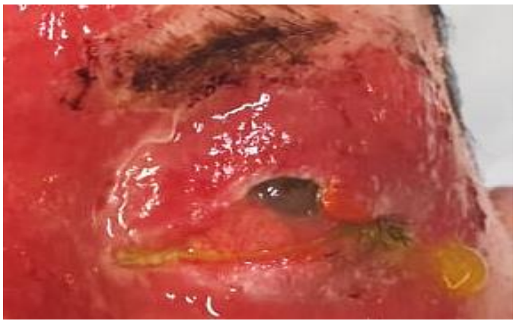

**Figure 7: A large full-thickness left upper eyelid defect can be appreciated during the pre-operative evaluation - perforated globe.**

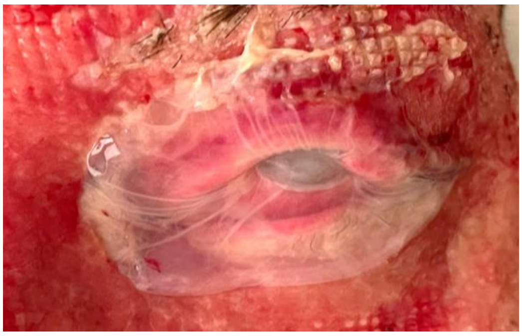

**Figure 8: Day 1 post left corneal amnion graft and amnion membrane transplant.**

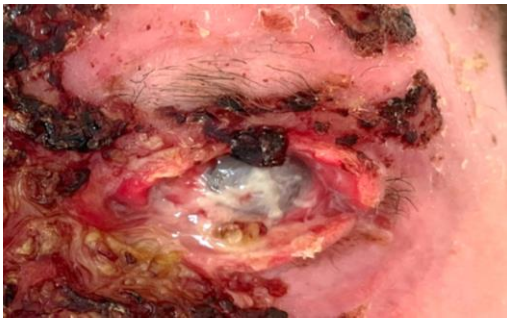

**Figure 9: Three-weeks post-surgery. Periocular skin almost fully granulated with new skin formation. Amnion membrane has dried and dissolved. Corneal amniotic membrane graft in situ and stable.**

During his hospital stay, his condition improved, and most of his wounds healed. He subsequently underwent a split thickness skin graft of his neck and left above-elbow stump. The graft took well. He received ongoing rehabilitation from occupational and physiotherapy. He was successfully discharged home. Regarding his ocular injuries, the future management plan will consist of a left upper eyelid reconstruction and possibly a corneal transplant for visual restoration. Continued ophthalmologic reviews will be performed.

## DISCUSSION

Electric burns, particularly high-voltage injuries, can cause severe multi-system damage, including ocular injuries, and are associated with higher morbidities, longer duration of hospital stay and higher mortalities.[3,5] The mechanisms of injury—particularly those linked to criminal activities such as cable theft—pose a significant public health concern, especially in developing countries like South Africa.[9]

A list of complications that can be expected from electric injuries are superficial to full-thickness burns, minor and major amputations, compartment syndrome, organ-specific injuries (cardiac, lung, liver, acute renal failure), coma, peripheral nerve injuries, glaucoma and shock (hypovolemic or septic).[5] These complications can further be classified as either early onset or delayed.[5] The case patient required a major amputation (left above elbow amputation), reflecting the high amputation rates of 10-68% in high-voltage injuries.[5] His elevated creatine kinase of >20,000 U/l, indicated muscle breakdown (rhabdomyolysis), increasing the risk of acute kidney injury (AKI), though his renal function remained stable.

Ocular involvement in electrical burns, though rare (approximately 5%), can be devastating.[10] The four main mechanisms of ocular injury—direct electrical effects, thermal damage, ischemia, and secondary trauma—can lead to damage to multiple ocular structures.[6-8] It may result in conjunctival hyperaemia, chemosis, loss of eyelashes or eyebrows, trichiasis in severe eyelid burns, lagophthalmos and exposure keratopathy from upper eyelid contraction.[7] Corneal damage is the most common ocular complication.[4] Patients may exhibit interstitial opacities along with damage to the corneal epithelium and endothelium.[7] In cases of severe burns, total opacification, thinning, tissue death, and perforation of the cornea may occur.[7] All these ocular manifestations were evident in the case patient, and unfortunately, due to the severity of the nature of his injuries, the left globe rupture led to unilateral visual loss.

Other reported complications are: cataracts, which can develop within hours to months post-injury, optic neuritis and macular damage, and full-thickness eyelid defects, the latter having a poor prognosis.[4,7,9-11] In severe cases, these injuries can lead to permanent blindness, reinforcing the need for early ophthalmologic intervention. Another possible pattern of injury that can arise from electric burn-related ocular injuries is asymmetry, an injury pattern that was notable in the case patient, as he had greater damage to his left eye.[7] This likely resulted from the asymmetrical proximity to the path of the electric current, supporting findings from previous literature.[7]

## CONCLUSION

Although electrical burn injuries are relatively uncommon, they pose serious public health challenges due to their high morbidity, long-term disability, and rehabilitation needs. Early multidisciplinary intervention—including general, trauma and plastic surgery, ophthalmology, and rehabilitation—plays a crucial role in improving patient outcomes. This case underscores the critical role of ophthalmology in identifying, treating, and preventing further deterioration of ocular structures following high-voltage electric burns. The integration of specialized ophthalmologic care in burn management significantly improves functional outcomes, highlighting the need for prompt intervention and multidisciplinary collaboration. Furthermore, this case highlights the severe ocular and systemic complications associated with high-voltage electric burns. The unique asymmetrical injury pattern emphasizes how the path of electrical current influences tissue damage. Due to late ophthalmologic intervention, the patient suffered significant visual loss, underscoring the need for timely and aggressive management of electrical burn-related ocular injuries. Future management of this patient will involve upper eyelid reconstruction and potential corneal transplantation, highlighting the long-term consequences of electrical burns on visual function and quality of life. Electric burns, particularly those involving criminal activities like cable theft, are a public health concern. Preventive education, strict enforcement of safety regulations, and improved electrical infrastructure security are essential to reduce these incidents.

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