

# A case report of a high voltage electrical injury: Lower limb Salvage with age-old technique of bone trephination and Split-thickness skin grafting

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## ABSTRACT

**Introduction:** Electrical injuries make up a relatively small portion of burn injuries. In electrical burns, limb damage is severe. Open wounds having exposed bone can be managed by simple trephination of bone and split thickness grafting when complex coverage options like muscle flap or free flap are not possible. **Case report:** We present the case of a middle-aged woman who sustained a high voltage electrical injury to left upper limb and left lower limb. Amputation of the left upper limb was done with shoulder disarticulation and subclavian ligation. In the lower limb almost whole length of the tibia was exposed which was drilled and surrounding area was debrided and then regularly dressed with saline dressing. Follow up three months of saline dressing resulted in good granulated wound ready for coverage which was skin grafted and limb was saved. **Conclusion:** Open wounds with exposed bones should be adequately debrided, and the attempt of drilling can be given if better coverage option is available. It is also an option when the patient is at high risk for surgery. It can be done under local or no anaesthesia. Regular dressing with local debridement and maintaining proper Hemoglobin and protein throughout can help early wound closure.

**KEYWORDS** high voltage electrical injury, limb salvage, bone drilling, bone trephination, STG over bone, Shoulder disarticulation

## INTRODUCTION

Contact electrical burns are more severe than other forms of contact burn injury. They lead to an array of complications that involve multiple systems, including cardiac arrhythmias and rhabdomyolysis.[1] In contrast to the medical complications, soft tissue injuries are devastating and surgically demanding.[1] The surgical treatments practised are escharotomy or fasciotomy, excisional debridement and limb amputation. Early fasciotomy was traditionally employed to treat compartment syndrome caused by deep muscle necrosis and tissue oedema. Despite

early fasciotomy as a limb-saving measure, there are still cases of limb amputation being reported.[2,3] This article describes a case of high voltage electrical injury to the left upper limb and left a lower limb in which amputation of the left upper limb was done with shoulder disarticulation and subclavian ligation. In the lower limb almost whole length of the tibia was exposed which was drilled and surrounding area was debrided later regular dressing done. Daily saline gauze dressings were done, and whenever required blood was transfused and high protein diet instituted. When the wound was ready, it was grafted. Successful grafting followed by graded physiotherapy, the patient was able to walk.

## CASE REPORT

A 48-year-old woman coming from a village in Gujarat, sustained electrical burn injuries while hanging clothes using a metal pole on a wire, which accidentally landed on a high voltage cable (11,000 V). She arrived in the emergency department in our hospital one day after the time of injury. On initial ex-

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Figure 1 and 2: On presentation.



Figure 3 and 4: Post debridement and drilling of bone.



Figure 5 and 6: Post split thickness skin grafting.



Figure 7 and 8: One year follow up pictures after skin graft has settled.



amination, she had full thickness burn wounds all over the left upper limb and in the left lower limb below knee there was tissue loss exposing the whole length of the tibia, with movement present in the foot but no sensation. Thus, constituting 15 % of total body burns. The entry point of the electrical arc was at left palm, and exit point was shin of the left leg. Left upper limb was not viable up to shoulder joint, with no sensation, no capillary refill and no movement. She had myoglobinuria with 500cc dark red urine on presentation. Early wound care was done with liquid paraffin-based dressing. Blood results revealed severe rhabdomyolysis (creatinine kinase level = 26000 U/L) and acute kidney injury (139.6  $\mu$ mol/L). Troponin 'T' was normal and an electrocardiogram showed sinus tachycardia, which ruled out cardiac injuries.

An emergency left upper limb shoulder disarticulation with subclavian ligation and debridement of lower limb wound was done in Operation Theater. In the postoperative period, Urine output was maintained at more than 1cc/kg/hour, and she had clear urine 36 hours after operation with a reduction of creatine kinase (CK) level from 26000 U/L to 3000 U/L after five days. She underwent multiple debridements and bone trephination every 3 to 4 days from day 3 of her injuries. Mobility assessment revealed that plantar flexion was present in the foot. The debrided wound developed an infection, and tissue cultures grew *Pseudomonas*, which was treated with intravenous Amoxicillin Clavulanate for two weeks. She eventually developed healthy granulating wound bed over the lower limb. The split skin graft was done after 12 weeks of dressing and it epithelized after a 3-week stay in the hospital, and the patient was subsequently transferred to a rehabilitation unit to continue rigorous rehabilitation and physiotherapy.

## DISCUSSION

Electrical burns have an inherently different mechanism and distribution of tissue injury as compared to thermal burns. While the majority of injuries following a thermal burn are clinically apparent whereas electrical burns may not be visible on initial clinical presentation.[3] Within 48 hours of injury, a compartment syndrome may develop in an involved extremity secondary to progressive myonecrosis as well as to fluid resuscitation. If not addressed promptly, increased interstitial pressure results in decreased perfusion of otherwise uninjured tissues, resulting in irreversible damage necessitating amputation.[3] Standard management of severe extremity electrical injury includes early surgical exploration, fasciotomy and debridement within 24 hours of injury. Early fasciotomy is defined as fasciotomy performed during a patient's first trip to the operating room.[4,5] It is warranted in patients with a high voltage electrical injury that is complicated by compartment syndrome of the affected body compartments. Rates of 10 to 50 percent of early fasciotomies performed within 24 hours for compartment release have been reported, and these have reduced the rates of limb amputations.[3,6-8]

However, immediate fasciotomy and decompression of muscle compartments of injured limbs are still controversial. Although some advocate this aggressive procedure to reduce the possibility of amputation, the approach may increase the number of surgical interventions required and lead to soft tissue desiccation by exposing viable tissue.[9] According to Mann et al., the ideal time to determine the extent of muscle injury is 3-5 days after electrical injury. They presented an algorithm for selective decompression to prevent subsequent morbidity[2,9]

and reported that progressive neurologic deterioration (motor or sensory) of the extremity, severe pain in the extremity and loss of arterial Doppler signal indicating cessation of perfusion are strong indications for a fasciotomy.[2] When presented with a fixed neurological deficit, irreversible nerve damage should be considered as fasciotomy may not improve the outcome of restoring limb function.[2] Late signs of vascular and neurological compromise may also have a poorer outcome in limb salvage. Measurements of intra-compartmental tissue pressure using a needle, catheter or fiberoptic transducer may objectively indicate for an early fasciotomy when the pressure rises to more than 30mmHg.[10] Pressure measurement, however, is not reliable for all patients with electrical injury of the extremities because oedema does not always occur in patients with normal superficial but damaged deep muscles.[9] Other non-invasive methods to assist in the diagnosis of compartment syndrome include an ultrasonic device (measures submicrometric displacement of fascia caused by volume expansion), near-infrared spectroscopy (tracking of variations in the oxygenation of muscle tissue) and laser Doppler flowmetry.[10,11] However, there are no studies to validate the accuracy of these non-invasive devices in diagnosing compartment syndrome.[10]

Early fasciotomy releases the pressure within a compartment under tension and restores adequate perfusion to viable tissues, which prevents tissue necrosis. In marginally injured tissues seen in the zone of stasis surrounding the necrotic burn zones, early fasciotomy improves tissue perfusion and prevents further necrosis of burn tissue. The drawback of this procedure is that it exposes the tissues to desiccation and wound infections.[2] In a relatively recent study, early fasciotomy was associated with a significantly increased number of ICU days, ventilator days, hospital days, and a total number of surgical procedures when compared to patients who did not have early fasciotomy. Since it was associated with increased injury severity, early fasciotomy was also associated with a significant increase in amputation.[3] Nevertheless, the possibility of inadequate decompression following fasciotomy leading to avoid tissue desiccation, subsequent wound sepsis and a protracted hospital course in patients requiring early fasciotomy, secondary wound closure is advocated on the third or fourth day with concurrent intra-compartmental pressure monitoring. Alternatives other than skin grafting for wound closure include intra-cutaneous skin sutures, skin stretching with mechanical closing devices, dynamic skin sutures, vacuum-assisted closure, and shoelace suturing techniques. When open wounds are encountered in lower limb as in this case, debridement should be generously done, and exposed bone should be given an attempt of drilling when other coverage options are not possible.[12]

## CONCLUSION

Open wounds with bone exposed should be debrided correctly and attempt of drilling can be given if no coverage option available. It is also an option when the patient is at high risk for surgery. It can be done under local or no anaesthesia. Regular dressing, local debridement and maintaining proper Hb and protein throughout can help early wound closure.

## TAKE HOME MESSAGE

In rural areas of Gujarat, the practice of using wires and metals for wet hanging clothes is very common, public education regarding safety is necessary to prevent such burns incidents.

Prompt and early referral to the higher centre is necessary for limb and life salvage.

### AUTHORS' CONTRIBUTIONS

Dr Hardik Dodia wrote the case report including performing the literature review. Dr Manav Suri and Dr Jayesh Sachde were involved in the literature review and helped draft part of the manuscript. Dr Pankaj Pandor helped in the management of the patient. Dr. M. F. Shaikh has supervised the writing and the general management of the patient. All authors read and approved the final manuscript.

### PATIENT CONSENT

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

### COMPETING INTERESTS

The authors declare that they have no competing interests.

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