ELECTRICAL BURNS

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INTRODUCTION :

The paper is based on a study of electrical burns in a major teaching hospital in a metropolitan city.

Electrical burns constitute a problem of a different nature than other types of burns. They are localised and although not so common, they require specialised care since the majority of them involve hands.

Unlike thermal burns where the main denominator is the temperature, in electrical burns several other factors play a part because of wide variations in physical properties of electrical current such as type, voltage, pathway, surface area of contact and duration of contact. This, together with different conductivity of various body tissues constitute the pathophysiology of electrical injury. Electrical burns also differ from thermal burns in their severity, the associated protracted primary shock, the thickness of slough and its slow progress of healing.

Whilst most thermal burns in different individuals look alike, electrical burns very considerably in appearance and it should be remembered that the severity of the electrical burns is most often not apparant at the initial examination.

Serious disturbances can affect other systems, Cardiac, respiratory, neurological and even intra-abdominal injury can occur concomitantly with electrical burns.

PATHOPHYSIOLOGY :

Pathophysiology of the electrical burns can be divided into—

(*A*) *Pathophysiology of electrical injury :*

The severity of the electrical burn is determined by (1) the voltage of the current, (2) the intensity or amperage, (3) the resistance at the point of contact, (4) the resistance at the point of grounding, (5) the duration of the contact, (6) the pathways of the current through the body, (7) the type of current, (8) the surface area of contact and (9) the victim's individual susceptibility of electric current (Peterson and Gibney, 1979).

(*B*) *Pathophysiology of electrical wound :*

These wounds may be divided into following three categories. Accurate recognition of these three types of wounds is important in the initial management and wound management (Artz, Moncrief and Pruitt, 1979). (1) True electrical wound is caused by passage of an electric current through the body. the characteristic entry and exit wounds usually signify local destruction of deeper tissues. (2) the second type of wound is because of burn produced by current coursing along the surface of the body. This burn is because

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of very high temperature (approximately 2500°C) of the arc mainly and is associated with high tension current. (3) The third type of wound is the flame burn resulting from ingnition of clothing by electric spark or arc. These burns have the characteristics of the usual thermal burn (Salisbury and Dingeldein, 1983).

MATERIALS AND METHODS :

Over a 17 years period from 1963 to 1979, 3980 cases of burns were admitted in the B. Y. L. Nair Hospital, Bombay, out of which 415 cases were of electrical burns. The ratio of admission for thermal burn to electrical burn was found to be 9.6 : 1, which is on the higher side for electrical burns. This may be due to immediate admission of all cases who are brought with a history of having had contact with live electricity even if they do not have an actual burn.

Table I

Analysis of Electrical burns over 5 year period.

Period 1972 to 1976 Operated cases		25
Total number of cases		134
Mean age		23.50 years
Sex : Male		114
Female		20
Ratio : Male : Female		5.7 : 1.
Part injured :		
Upper extremity	52	75.4%
Lower extremity	7	10.1%
Others	10	14.5%
Nature of injury :		
Electrical injury	99	74.6%
Electrical burn	33	24.6%
Thermal burn	2	.8%
Casuative factors :		
Domestic	84	62.7%
Industrial	38	28.4%
Others	12	8.9%

A further detailed analysis was made on electrical burns cases over the last five year period. Out of 134 cases of electrical burn, only 25 cases required surgery. The incidence of male was far more, unlike the common thermal burns where females predominate. Although the causative agent even in the majority of electrical burns was domestic, electrical burns of the mouth were quite rare in our series in contrast to western reports.

Table II

Clinical manifestations

(134 cases)

Causative factors :	
A. True electrical	128
B. Arc or flash	4
C. Thermal electrical	2
Types of burns :	
A. Superficial loss	15
B. Deep loss	26
C. Extensive loss	4
Complications :	
A. Local	7
B. Systemic	4

The arc, where a flash produces a temperature of 2500°C but where there is no direct contact with the skin may sometimes produce extensive burn (Dale, 1954) and when there is an associated thermal component, this may produce very deep burn even with loss of eyesight. (Fig. 1) Most burns were of deep variety and seven had local complications like injury to vessels, nerves, tendons and bones (Fig. 2). The alternate current for its tetanizing effect may be more dangerous than direct current. The passage of current through vital organs may prove fatal (Cason 1981).

Table III

Nature of surgery in electrical burns (25 cases)

Debridement	
A. Early	3
B. Delayed	15
C. Late	7
Cover	
A. Split skin graft	12
B. Flap	7
C. Pinch graft	3
Amputations	
A. Minor	5
B. Major	3
Surgery for tissues other than skin	
A. Tendon	1
B. Bone	1
C. Fasciotomy	2

We have done a wide variety of surgical procedures for the management of electrical burns. Since all burns are admitted on the General Surgical units in our hospital, most debridement was done as a delayed procedure.

We have done pinch graft in small localised electrical burns. We have found pinch graft to be extremely hardy and they have a definite place in management and early healing of small deep burns.

Flaps as a primary procedure have been used in a relatively large number of cases with very good results (Fig. 3,4,5).

Delayed procedures such as a tendon graft after providing flap cover over an old, deep electrical burn with loss of tendon, had to be done in some cases. (Fig. 6,7,8).

CONCLUSIONS :

Electrical burns even without the extensive use of domestic appliances as in the West are of fairly common occurance in our city.

The most commonly involved sites are extremities, the upper extremity being more frequently involved. Since more frequently electrical burns are localised to hand, specialised care is required.

As far as management of wound is concerned we need debridement, skin cover and tendon or bone graft. Our experience with pinch graft is gratifying because it takes even on unhealthy wound with little discharge and the graft is hardy. Most cases came for specialised care rather late and since the tissue damage varies extensively, considerable versatality in management is called for.

SUMMARY :

The pathophysiology of electrical burns and the ways it differs from thermal turns are discussed.

134 cases of electrical burns during 5 years period are presented, out of which only 25 cases required different types of specialised surgical management.

ACKNOWLEDGEMENT :

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Fig. 1. A-P view showing very deep burn with the loss of eyesight.

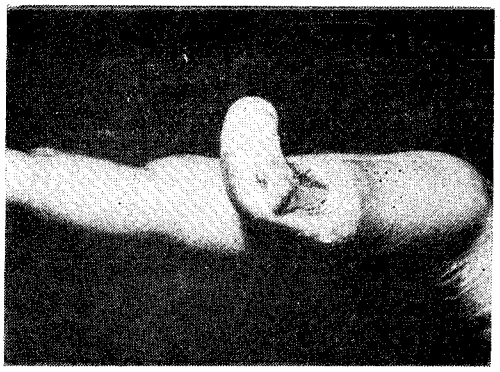

Fig. 2. Deep burn with both the phalanges of the (L) thumb exposed.

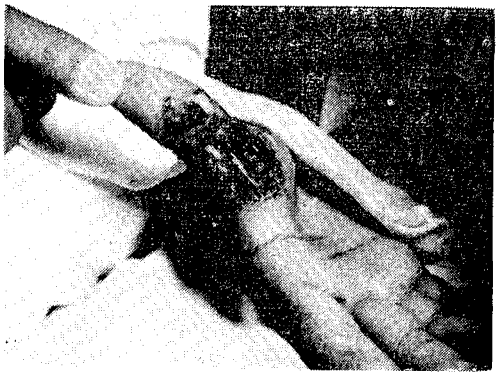

Fig.3. Very deep electrical burn of 1st web space.

Fig. 4. Flap from inguinal region to cover defect.

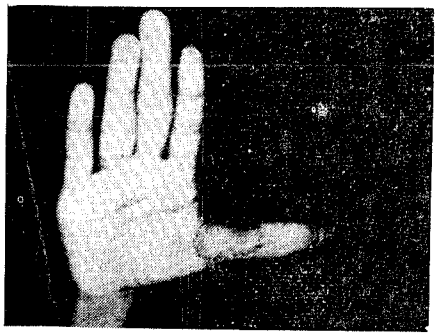

Fig. 5. Following division of the flap.

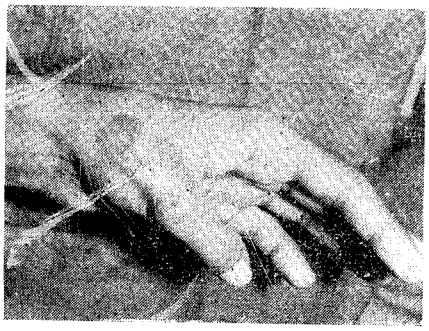

Fig. 6. Old, deep electrical burn with severe scarring and loss of extensor pollicis longus.

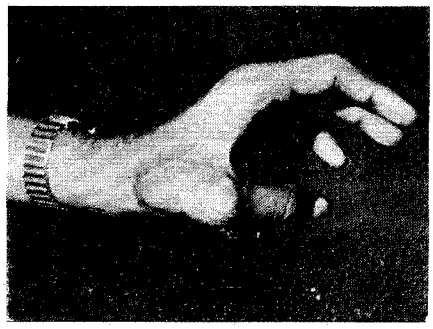

Fig. 7. Following excision of scar and covering with skin flap (immediate P.O.)

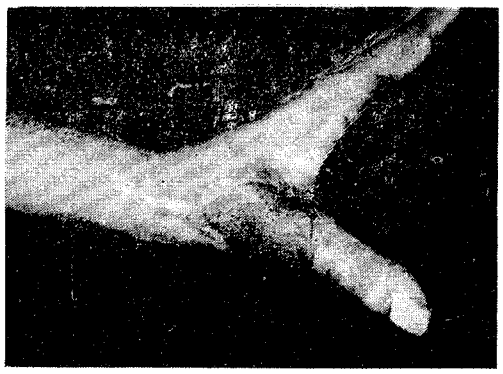

Fig. 8. After defatting and tendon graft showing extension of thumb.

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