RECONSTRUCTION OF POST ELECTRIC BURN DEFECTS OF UPPER LIMB WITH DIFFERENT FLAPS
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ABSTRACT: INTRODUCTION: Post electric burn defects are difficult to manage due to deep injury involving all the structures up to bony level. A good vascularized flap is required to resurface the defect for preventing the complication and for reconstruction of involved structures.

AIM: Resurfacing the post electric burn defect with different flaps according to need of the defect.

MATERIAL AND METHOD: All patients of electric burn hand and fore arm defect admitted to burn, plastic and reconstructive department of SCB Medical College & Hospital, Cuttack between January 2012 to December 2012 were included in the study. During this period the patients were followed up at weekly interval for first 2 month, then at 1 monthly interval for next 6-8 month.

OBSERVATION: Out of 40 cases of post electric burn forearm and hand reconstruction, 10 cases underwent groin flap cover, 6 cases underwent abdominal flap cover, 5 cases underwent cross finger flap cover 5 cases underwent free anterolateral thigh flap cover, 4 cases underwent free latissimus dorsi flap cover, 5 cases underwent first dorsal metacarpal artery flap cover, 5 cases reverse radial forearm flap cover. All the defects were resurfaced successfully with flaps. Four had marginal necrosis and six had wound infection. Eventually all flaps settled well without further intervention. Due to involvement of all important tendons & nerves, functional outcome is guarded.

DISCUSSION: Hand and forearm are most commonly and most severely affected in electric burn injury because they are mostly first part of body to come in contact with electric circuit. Even though at initial part the injury appears to be superficial, deeper structures like bone, tendon and neurovascular bundles are affected requiring flap cover for future reconstruction of these structures to get functional and sensate hand.

CONCLUSION: Reconstruction of post electric burn defect of distal forearm and hand represents great challenge due to depth of injury involving full thickness of skin and other structures like neurovascular bundle and bones and tendons. Choice depends on size of defect, availability of local or regional tissue, patient’s acceptance and cooperation.

KEYWORDS: Electric burn, Defects of upper limb, Flap, Reconstruction.

INTRODUCTION: Electric burn injury is defined as tissue injury following exposure to electrical current or forces. Includes: direct contact burn, arc injuries, flash, and flame burns.¹ ² ³ Statistics: it contributes to 4% of admissions to burn centers & 5-10% all occupational fatalities.⁴ Classified according to Voltage <High (>1000V) vs Low (<1000V)>⁵ and type of injury (Arc, Thermoelectrical, Flash/Flame burn).¹ ² ³ While considering voltage, degree of injury increases proportionately with voltage.
PATHOPHYSIOLOGY: $V=IR$ (Ohm’s law) where $R$ is Resistance, $I$ is current. Resistance of skin (dry skin=100,000, wet=1000 ohms) and internal organ (Bone, tendon, fat) = 500-1000 ohms. Nerves, vessels, muscles are very good conductors of current. Again resistance is inversely proportional to cross-sectional area of joints, so small joints of body like joints of foot and hand suffers from maximum injury.\(^6\)

Electric burn is also classified according to type of current (Alternative current/Direct current), frequency (Hz), magnitude (mA), pathway. Alternative current injuries have more morbidity and mortality than direct current.\(^2\) Hand to hand pathway (across heart) produces more mortality.\(^7\) Standard household outlet (0.5mA, 60Hz, AC, 120V) in India produces startle response, cutaneous burns.\(^>10\text{mA}\) alternative current produces tetany, “locked-on” phenomenon.\(^>100\text{mA}\) alternative current produces loss of consciousness, asystole, and severe tissue injury.\(^1,2,6,8\) Long-term sequelae of electric burn include: Infection, scarring, contracture, neurologic deficits (For weeks/months post-injury), cataracts (Ophthalmologic exam in all cases of high voltage injury), extremity complications such as neuromas, phantom limb pain.\(^2,5\) Post electric burn upper limb defects are difficult to manage due to deep injury exposing: tendons, neurovascular bundles, bones. Therefore a good vascularized flap is required to resurface the defect for preventing the complication and with aim of future reconstruction.

AIM OF THE STUDY: Resurface the post electric burn hand and forearm defects with different flaps according to need of defect.

MATERIAL AND METHOD: All patients of electric burn hand and fore arm defect admitted to burn, plastic and reconstructive department of SCB Medical College Cuttack between January 2012 to December 2012 with different flap covers used for reconstruction. Patients were informed about their problem, various options available to cover the defects, with the aim of future reconstruction and informed consent taken for different flaps for cover.

OBSERVATION: We categorized our patients into different according to severity of injury they suffered (high voltage/ low voltage) and as isolated injury of upper extremity or injury of upper extremity associated with other defects.

Out of 40 patients of post electric burn forearm and hand defects we got 15 patients suffering from low voltage electric burn injury, 25 patients of high voltage electric burn injury (Table-1).

Isolated defects of upper extremity include 10 patients and defects of upper extremity associated with other defects included 30 patients (Table-2).

All the patients we came across are male patients & within age group of 20- 40 years. In all cases deep structures like tendon, neurovascular bundles and bones affected or exposed requiring flap cover.

Out of 40 patients of post electric burn forearm and hand defects, groin flap given in 10 cases, abdominal flap in 6 cases, cross finger flap 5 cases, free anterolateral thigh flap 5 cases, reverse radial forearm flap 5 cases, first dorsal metacarpal artery based flap 5 cases, free latissimus dorsi flap 4 cases (Table-3).
In two cases of groin flap cover we found proper maintenance of hand position by patient after flap cover difficult in initial period leading to partial detachment of flap, which was reinserted.

In one case of electric burn injury of hand, forearm (left) with loss of index finger, patient was advised below elbow amputation by Department of Orthopedics, but now the patient had functioning limb following free latissimus dorsi flap cover and flexor tendon reconstruction.

In all cases flaps settled well with good aesthetic outcome. Functional reconstruction planned in future according to need. Only in one case reconstruction of flexor tendon done during this period.

| Low voltage (<1000) | High voltage (> 1000) |
|---------------------|-----------------------|
| 15                  | 25                    |

Table 1: Segregation of patients according to voltage of injury suffered

| Isolated defects of upper extremity | Defects of upper extremity associated with other defects |
|------------------------------------|--------------------------------------------------------|
| 10                                 | 30                                                     |

Table 2: Segregation according to involvement with other parts

| Types of flap                              | Number of patients |
|--------------------------------------------|--------------------|
| Groin flap                                  | 10                 |
| Abdominal flap                              | 06                 |
| Cross finger flap                           | 05                 |
| Free anterolateral thigh flap               | 05                 |
| Reverse radial forearm flap                 | 05                 |
| First dorsal meta carpal artery based flap (FDMA FLAP) | 05 |
| Free latissimus dorsi flap                  | 04                 |

Table 3: Types of flap used and number of patients

**DISCUSSION:** Hand & forearm are most commonly & most severely affected in electric burn injury because they are mostly first part of body to come in contact with electric circuit. Even though at initial part the injury appears to be superficial, deeper structures like bone, tendon & neurovascular bundles are affected requiring flap cover for future reconstruction of these structures to get functional and sensate hand. Despite of all efforts complete regain of function & sensation in hand and forearm is very difficult. Out of various option available for resurfacing of defects we have to choose one option taking into consideration, availability of local tissue, size of defect, availability of regional tissue, condition of neurovascular bundle at recipient site. In our study we had used groin flap in most of the cases, as local tissue is not available in most cases for resurfacing the defect, groin flap is easily available option with proper positioning of hand without much discomfort to patient. Next easily available option is abdominal flap. Reverse radial forearm flap can be used in cases with availability of local tissue in radial forearm territory. Cross
finger flap and FDMA flap used for covering small defects over finger. Free flap can used for reconstruction of large defects which cannot be covered by other option.

**CONCLUSION:** In electric burn injury of forearm & hand males are most commonly affected with age group ranging between 20 -40 years.\(^4,10\) Resurfacing of post electric burn defect of distal forearm and hand represents great challenge due to depth of injury involving full thickness of skin and other structures Choice depends on size of defect, availability of local or regional tissue, patient’s acceptance and cooperation, keeping in mind the cost effectiveness of the procedures.

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FREE ANTEROLATERAL THIGH FLAP FOR POST ELECTRIC BURN DORSUM OF HAND RECONSTRUCTION

FREE LATTISIMUS DORSI FLAP FOR POST ELECTRIC BURN FOREARM RECONSTRUCTION

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