



## RECONSTRUCTION OF POST ELECTRIC BURN DEFECTS OF UPPER LIMB WITH PEDICLED FLAPS: IS IT STILL A VALID OPTION?

<b>Dr. R.K. Maurya</b>	Professor in general surgery , MMRA Medical College , Ambedkarnagar.
<b>Dr. Prem Shankar</b>	Professor in general surgery, GSVM Medical college.
<b>Dr. Pushendra Kanaujiya</b>	Assistant professor in general surgery, GSVM Medical College , Kanpur.
<b>Dr. Nikhil Chauhan*</b>	Resident in general surgery , GSVM Medical College , Kanpur. *Corresponding Author

**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.

**Aim of study:** To study the various pedicled flaps used for coverage of various post electrical burns defects and to analyse the outcome of flap.

**Material and method:** The study was conducted in the department of general surgery, Associate LLRM Hospitals, GSVM Medical College, Kanpur from January 2019 to October 2020 on patients who was admitted from casualty and outpatients department with a diagnosis electric burn injury of upper limb

**Observation:** In patients with post electric burn forearm and hand reconstruction, early fasciotomy, repeated debridement and non postponement of definitive flap helped to reduce morbidity and improving quality of life of patient apart from reducing total hospital stay. Flaps have resurfaced the defect with minor complication like infection and minor necrosis of flaps, which were managed either conservatively or using antibiotics. Functional outcomes were satisfactory.

**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. Choice of pedicled flap depends on site of defect, availability of local or regional tissue, patient's acceptance and cooperation, keeping in mind the cost effectiveness of the procedures.

**KEYWORDS :** Electric Burn, Pedicled Flaps, Upper Limb, Complications, Functional Outcomes

### INTRODUCTION

**Electrical burn** is a unique form of trauma, in which mortality and morbidity are very high as compared to thermal burns. It also includes direct contact burn, arc injuries, flash, and flame burns. It contributes to 4% of admissions to burn centres & 5-10% all occupational fatalities. The effects of electrical current depend on the type of current, voltage, tissue resistance, the pathway and the duration. **High-tension** electrical burns causes wide spectrum of injuries, i.e., cutaneous injuries, severe damage to underlying muscles, nerves, blood vessels and bones. Even, any organ system can also be injured by the passage of current. **Respiratory arrest, cardiac arrest, ventricular fibrillation, renal failure, gangrene** of the extremities are some of the early life threatening complications. Long-term sequelae of electric burn include infection, scarring, contracture, neurologic deficits (for weeks/months post-injury), cataracts (ophthalmologic exam in all cases high voltage injury), extremity complications such as neuromas, phantom limb pain. Post electric burn upper limb defects are difficult to manage due to deep injury exposing: tendons, neurovascular bundles, bones. Therefore, a good vascularised flap is required to resurface the defect for preventing the complication and have good esthetical and functional outcomes.

### AIMS OF THE STUDY

To study the various pedicled flaps used for coverage of post electrical burns defects and to analyse the outcome of flap cover.

### MATERIALS AND METHODS

The study was conducted in the department of general surgery from January 2019 to October 2020 on patients who was admitted from casualty and outpatients department with a diagnosis of electric burn injury of upper limb. Patients were informed about their problem, various reconstructive options available with the aim of future reconstruction and informed consent taken for different pedicled flap cover. Selection of patients was based on –

### INCLUSION CRITERIA-

- All patients of electric burn giving consent for treatment
- Electric burn injury of upper limb only
- Patients with <30% TBSA electrical burn injury

### EXCLUSION CRITERIA-

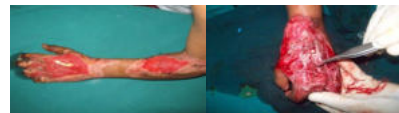
- Non-consenting patients

- Patient with positive viral markers
- Patients with associated life threatening injuries such as head injury, spinal cord injuries, etc.
- Patient with charred upper limb

A total of 60 patients with electric burn injury of upper limb were studied. Patients were given flap cover according to need of defect there were no strict criteria to fit the patient in each flap group. Type of debridement, length of hospital stay, timing of flap placement, complications and functional outcomes of different flaps were studied in this study. Data was collected and analyzed.

### Operative technique

Patients and their attendants were counselled preoperatively about procedure, its benefits and disadvantages. Preoperatively, after resuscitation and achieving hemodynamical stability, wound debridement is done. Flap was designed on selected area oriented along minimum skin tension lines and an area that allows maximum comfort to the patient to exercise elbow and shoulder joint.



**FIG. 1: Debridement of burn defect of upper limb**

Intraoperatively, flaps are raised to suitable thickness according to the need of defects. Flap was sutured to the defect using 3-0 nylon suture. Upper limb was strapped using tapes and bandages to abdominal wall, allowing inspection of flap.



**FIG. 2: Placement of pedicled flap**

Postoperatively, patient was mobilized only after 2-3 days and were allowed to exercise elbow and shoulder joint. Flap division was done after tourniquet test i.e. after 2-3 weeks while observing the colour of flap.



FIG. 3: Division of pedicle



FIG. 4: Final outcome

**RESULTS**

Out of the 60 patients , age ranging from 9 years to 50 years, maximum number of electric burns were found between age group 31-50(45%). Youngest child was 9 years old, sustained electric burn injury to hand while playing with kite and oldest patient in study was 50 years old, sustained injury accidentally while doing domestic work. Mean age of patients was 29.03±11.36. Out of 60 patients, 54 patients were male and rest 6 patients were female which is due to high association of work related electric burn injuries in upper limb.

Out of 60 cases, majority of cases needed serial debridement(45 cases) and rest 15 cases were debrided for only single time.

**Table-1- single stage debridement vs serial debridement**

SINGLE STAGE VS SERIAL DEBRIDEMENT	Total no. of patients (n=60)	
	No.	%
Single Stage Debridement	15	26.67%
Serial Debridement	45	73.33%
	<b>60</b>	<b>100%</b>

There were a total of 60 flaps done during the study out of which 18 flaps were done on 7<sup>th</sup> post burn day (groin flap = 6, bilobed groin flap = 9, superiorly based abdominal flap = 3 and inferiorly based abdominal flap = 0), 34 flaps were done between 1-2 week post burn interval (groin flap = 5, bilobed groin flap = 6, superiorly based abdominal flap = 10 and inferiorly based abdominal flap = 13) and only a few (8 cases) flaps were done after two weeks post burn interval (groin flap = 4, bilobed groin flap = 0, superiorly based abdominal flap = 2 and inferiorly based abdominal flap = 2)

**Table 2- Timing of flap cover**

TIMING OF FLAP	TOTAL PATIENTS (n=60)	
	No.	%
5 <sup>th</sup> Day Post Burn Injury	18	30%
1-2 Week Post Burn Injury	34	56.67%
2-3 Week Post Burn Injury	8	13.33%
	<b>60</b>	<b>100%</b>

Out of 60 patients mean hospital stay was 38.9±4.64 out of which patients with groin flap had a mean hospital stay of 39.47±5.19, bilobed flap had a mean hospital stay of 37.4±4.57, superiorly based abdominal flap had a mean hospital stay of 38.67±4.20 and Inferiorly based abdominal flap had a mean hospital stay of 40.07±4.57.

**Table 3- Mean length of stay in different flaps**

LENGTH OF HOSPITAL STAY	GROIN FLAP (n=15)	BILOBED GROIN FLAP (n=15)	SUPERIORLY BASED ABDOMINAL FLAP (n=15)	INFERIORLY BASED ABDOMINAL FLAP (n=15)
Mean	39.47	37.4	38.67	40.07
Standard Deviation	5.19	4.57	4.20	4.57

Out of 60 cases, 50 cases didn't have any complications any complications during their hospital stay. Maximum of 5 cases with complications occurred in groin flap group (2 with flap infections, 1 with partial flap necrosis and 2 with partial margin loss) only one case of flap complications was seen in all other flap group.

**Table 4- Complications in flaps cover**

COMPLICATIONS	TOTAL PATIENTS (n=60)	
	No.	%
Flap Infections	4	6.67%
Partial Flap Necrosis	3	5%
Total Flap Necrosis	0	0%
Partial Margin Loss	3	5%
No Complications	50	83.33%
	<b>60</b>	<b>100%</b>

Out of 60 cases almost all flaps had no functional abnormalities. Only two case in groin flap group had joint stiffness which was noticed during follow up in old age patient which was later relieved by physiotherapy and conservative treatment.

**Table 5- Functional outcomes in flaps**

FUNCTIONAL OUTCOME	TOTAL PATIENTS (n=60)	
	No.	%
Complete Movement	58	96.67%
Restricted Movement	0	0%
Stiffness	2	3.33%
Disability	0	0%
	<b>60</b>	<b>100%</b>

**DISCUSSION**

Electrical injury is one of the most serious injury of the modern Society and involvement of dominant upper extremity in the working age group of patients makes it more worrisome. Earlier, protocol of serial debridement of necrotic tissues until the entire wound has granulated, and then going for definitive wound coverage had unsatisfactory outcomes. Now, several groups are advocating early coverage of electrical injury wounds. Pedicled flaps has been widely used to cover electric burn defects of upper limb as they are quick, facile, reliable and are associated with low morbidity.

A study by Handschin AE et al(2007)[2] showed that average of 4.8 operations were performed per patient (range 1 – 23 operation) in a total of 61 patients. Surgical procedures included repeated debridement (100% of all patients), early escharotomy/fasciotomy (47.5%) and, 23% underwent reconstructive surgery using either local or free flaps. However In our study ,debridement was done in all 60 cases. Even though early wound debridement was done in most of the cases, we had to repeat the wound debridements in 73.33% of cases. So, serial debridement was done in 45 patients as compared to single stage debridement done in 15 cases. This done to reduce infective load , remove all devitalized structures and to make flap bed healthy.

Handschin AE et al(2007)[2] reported average 44 d of hospital stay and Noble J et al(2006)[1] in their study reported hospital stay 24.5 ± 21 d in electrical injuries. In our study, all the post electrical burn wounds were covered within 2-3 weeks flap. Most of flap cover(n=34) were done between 1 to 2 week of injury. Most of groin flaps were placed on 7<sup>th</sup> post burn day while all other flaps were placed between 1 to 2 weeks after electric burn.

In a study by Zancolli EA et al.(1986)[9], 8 who reported no complications whatsoever in their series of 25 cases. In a similar study by Ghosh JC et al(2014) [7] , About 86% of patients with groin flap had no loss of flap, 10.71% had marginal distal flap loss, 3.57% patient had distal flap loss up to 5% and no patient had distal flap loss >5%. Wang F et al.(2015)[8] reported the coverage of 9 hand dorsa with supratherin abdominal pedicle flaps, with only 1 flap undergoing partial necrosis. Our study showed 100% flaps survival. Total 2 flaps showed partial flap necrosis and 3 flaps showed partial margin loss , which was managed conservatively. Infection under the flap cover was noted in 4 cases, which was managed with antibiotics. No complete flap necrosis was reported in any flap. Most of the complications were reported in patients with groin flap

Graf P et. al.(1992)[10] reported restricted finger mobility in 4 out of 24 patients (17%) aging 50 years and above who underwent groin flaps for upper limb reconstruction. No other major asthetical outcome was noted in that study. In our study, most of the patients had good functional outcomes and returned to their work. Only 2 case of joint stiffness was seen in follow-up of cases of groin flap (13.33%), all other flaps showed no significant functional complication. The low rate of joint stiffness in our series may be caused by the relatively younger age of our patients and encouragement of routine exercise on the involved joints.

## CONCLUSION

In conclusion, pedicled flaps may be considered a valid, affordable and safe option in reconstruction of electric burn defects of upper limb, especially in cases where microsurgical techniques are not available. Choice of type of pedicled flaps 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. Although there are some disadvantages as it need multiple stages, longer hospital stay, are bulky; but the benefits outweighs the drawbacks. Thus pedicled flap is thus a safe and effective method to salvage hand function

## CONFLICT OF INTEREST

Author declare no conflict of interest.

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