



Plastic Surgery

A CLINICAL STUDY OF ROLE OF ABDOMINAL FLAPS IN RECONSTRUCTION OF DEFECTS OF FOREARM AND HAND

Dr Kalahasthi Bharathi	Ms, Mch, Plastic Surgery Superspeciality Post Graduate Resident, Osmania Medical College, Hyderabad, Telangana, India
Dr Ajay Kumar Mareedu*	MS, MCh Plastic Surgery Superspeciality , Assistant Professor Andhra Pradesh India *Corresponding Author
Dr. G Rangaswamy	Ms Mch, Professor Of Plastic & Reconstructive Surgery. Department Of Plastic Surgery, Osmania Medical College, Hyderabad, Telangana, India
Dr. Sukhavasi Sree Sai Rekha	MS Mch Department Of Plastic Surgery, Osmania Medical College, Hyderabad, Telangana, India
Dr. Pendkar Shivani	MS, MCh, Plastic Surgery Superspeciality Post Graduate Resident, Osmania Medical College, Hyderabad, Telangana, India
Dr. Sana Banu	MS, MCh, Plastic Surgery Superspeciality Post Graduate Resident, Osmania Medical College, Hyderabad, Telangana, India
Dr. Maseera Ambreen	MS, MCh, Plastic Surgery Superspeciality Post Graduate Resident, Osmania Medical College, Hyderabad, Telangana, India
Dr. Digala Shankar	MS, MCh Plastic Surgery Senior Resident, Osmania Medical College, Hyderabad.

ABSTRACT

Background: Soft tissue defects of the hand and forearm are common and may pose a challenge to the reconstructive surgeon. Various procedures of reconstruction such as use of local, regional, distant, and free flaps have been described. In this study it is aimed to report the techniques, outcomes, and complications of pedicle abdominal flaps in reconstructing hand and forearm defects. Abdominal flap is a simple, easy, robust and versatile distant flap that took a great place in the beginning of era of reconstructive surgery. Pedicle abdominal flap was one of the initial methods of reconstruction for hand and forearm defects, still efficiently performed for post electric burn and traumatic hand defects. **Methods:** This retrospective clinical study includes Twenty-eight (28) patients with defects of distal forearm and hand due to trauma and electrical burns and tumors admitted in the department of Plastic and Reconstructive surgery, Osmania General Hospital, and MNJIO & RCC, Hyderabad, Telangana, admitted from December 2019 to November 2021. **Results:** Total of 28 patients were included in the study. Two patients had 2 flaps done. So, total 28 patients 30 flaps are included in the study. Of the 30 defects in 28 patients, 2 defects extended in 2 sites. So, there are total 32 sites of defects. Of the 32 sites, most common site is wrist & ventral forearm with 11 (34.4%) defects followed by dorsum of hand with 10 (31.3%) defects. In this series, superiorly based abdominal flaps done in 9 (30%) patients, inferiorly based abdominal flaps done in 3 (10%) patients, groin flaps done in 8 (26.7%) patients, hypogastric flaps done in 7 (23.3%) patients and combined groin & hypogastric flaps done in 3 (10%) patients. Most common presentation was due electrical injuries followed by road traffic accidents (RTA). **Conclusions:** Pedicle abdominal flaps are a valid, technically less demanding, affordable, and safe option in hand and forearm defects, especially where microsurgical teams and major operation theatre facilities are not available round the clock or where they are not the best option for reconstruction.

KEYWORDS :**INTRODUCTION**

Hand is one of the most important parts of human body because of its mechanical and sensory functions. Victims range from infants to adults. Injury can be a simple cut to a mutilating hand. Hand traumas are caused by machinery/ motor injuries, road traffic accidents, electric burns etc. in our country. Underlying and surrounding tissue, muscles, vessels and nerves may be involved and can also be grossly damaged. Bone and tendons may be involved and get exposed and lead to their loss of function.

They are quite often sufficient enough to restrict daily activities accounting for days lost from work. It is therefore important that acutely injured hand is managed adequately to prevent infection, salvage the injured part, promote primary healing and restore its function.

Different reconstructive methods have been used to treat these defects with the aim to restore the function of hand and also the cosmetic aspects. Soft tissue reconstruction of the upper extremity requires strict adherence to standard surgical principles with options of primary closure, secondary closure, skin grafting, local pedicle flaps, distant pedicle flaps or free flaps. Free flaps and other microsurgical techniques have been used to achieve early, functional, and custom-tailored reconstructive solutions for upper limb injuries.¹ However, despite the superiority of free flaps, this option may not be always accessible, especially in developing countries, owing to the high cost

and technical demands.² The choice of which technique to employ depends mainly on the size, site, nature and complexity of the defect. Our goal is to restore a functional, sensate, and aesthetically acceptable hand.

The pedicle abdominal flap is the fundamental reconstructive principle of restoring both form and function therefore guides the management of patients with defects in upper extremities. Considering the large volume of patients presenting with variations in type, level, duration and contamination of injury, the aim of the operating surgeon would be to ensure primary wound healing within an optimum time frame with a safe and reliable procedure.³ Abdominal flap is a simple, easy, robust and versatile distant flap. Pedicle abdominal flap was one of the initial methods of reconstruction for hand and forearm defects, still efficiently performed for post electric burn and traumatic hand defects. Literature supports long term outcomes of successful pedicle flaps which are equal or even better than free flaps.⁴ Due to these reasons abdominal and groin flaps continue to be the workhorse flaps in the developing world as well as at our centre for major hand injuries with composite tissue loss.³

METHODS

This was a retrospective study done in the Department of Plastic Surgery, Osmania General hospital, Hyderabad, Telangana, India over a period of 2 years, from dec 2019 to nov 2021. All patients with Defects over distal forearm, hand and fingers exposing tendons are

included in this study.

Wounds treated by primary closure or skin grafting were excluded from the study. Patients with polytrauma and those requiring emergency surgical procedures for other conditions were excluded from the study. A total of 28 patients were included in the study.

The data of the patients with respect to age, sex and nature of injury were tabulated. Patients who are presented with injuries to distal forearm and hand due to trauma (road traffic accidents and machinery injuries) were thoroughly evaluated for any associated injuries. Patients with associated injuries like fractures were stabilized in the department of orthopedics and were referred to plastic surgery department. In addition to this upper limb radiography was done to know the status of underlying bones and colour Doppler was done to know the status of upper limb vessels. Once the patient was found fit for surgery, He/she was taken up for initial wound cleansing and debridement followed by primary flap cover.

Patients admitted with electric burns were initially resuscitated from shock and after the patients' general condition is stabilized, swabs were collected for culture and sensitivity. After serial debridement when the wound is ready patient was taken up for secondary flap cover.

Patients with soft tissue tumour of forearm and hand will be evaluated by surgical oncologist, and after appropriate treatment by the oncologist, plastic surgeon will decide the flap cover for the defect.

Planning is done preoperatively on conscious patient, using uninjured limb as a model. It will also permit the planning of position of comfort for the patient and maximum. Definitive planning is carried out under anaesthesia. Choice of the abdominal flap is as dictated by the need and is made possible by the surgeon's experience. All patients received comparable post-operative care including antibiotic therapy, anti-edema measures and flap monitoring.

Three weeks later patients were taken up for delay. This vascular delay is most commonly achieved by interrupting a portion of the normal blood supply to the flap. 5 - 7 days after delay patient can be taken up for division and inset of the flap.

Patients were followed up for a period of 3 months after surgery. They were advised to perform physiotherapy exercises and massage with emollients to keep the skin moist and joints supple.

RESULTS

Table1: Age distribution of patients in the study.

Age (years)	No .of patients	Percentage
10-20	4	14.3%
21-30	8	28.6%
31-40	8	28.6%
41-50	6	21.4%
51-60	2	7.1%

Of the 28 patients, The age of patients ranged from 10 to 60 years in this study. Common age group affected is between 21 to 30 years (n=08) and 31 to 40 years (n=08) constituting 28.6%.

Table 2: Sex distribution

Gender	No. of patients	Percentage
Male	25	89.3%
Female	3	10.7%

Out of 28 patients, 25 (89.3%) patients are males and 3 (10.7%) patients are females.

Table 3: Etiology of hand and forearm defects

Etiology	No .of patients	Percentage
Suicidal	1	3.6%
Electrical burns	13	46.4%
Tumour	2	7.1%
Road traffic accidents	7	25%

Most common etiology of hand and forearm defects is electrical burns in 13 (46.4%) patients followed by RTA in 7(25%) patients.

Table4: Site of defect

Site of defect	No .of defects	Percentage
Fingers	4	12.5%

palm	1	3.1%
Dorsum of hand	10	31.1%
Wrist & ventral forearm	11	34.4%
Dorsum of wrist & forearm	5	15.6%
Distal end of amputated hand	1	3.1%

Of the 30 defects in 28 patients, 2 defects extended in 2 sites. So, there are total 32 sites of defects. Of the 32 sites, most common site is wrist & ventral forearm with 11 (34.4%) defects followed by dorsum of hand with 10 (31.3%) defects.

Table 5 Size of defect

Size of defect (longest dimension)	No.of patients	
<7cm	2	6.7%
07-10 cm	18	60%
>10cm	10	33.3%

Size of defect ranged from 6 to 1s (longest dimension). 18 (60%) defects are within 7 – 10 cms, 10 (33.3%) defects are > 10 cms and 2(6.7%) defects are < 7 cms.

Table 6 : Types of flaps.

TYPES OF FLAPS	No. of patients	Percentage
SUPERIORLY BASES FLAPS	9	30%
INFERIORLY BASED FLAPS	3	10%
GROIN FLAPS	8	26.70%
HYPOGASTRIC FLAPS	7	23.30%
GROIN & HYPOGASTRIC FLAPS	3	10%

In this series, superiorly based abdominal flaps done in 9 (30%) patients, inferiorly based abdominal flaps done in 3 (10%) patients, groin flaps done in 8 (26.7%) patients, hypogastric flaps done in 7 (23.3%) patients and combined groin & hypogastric flaps done in 3 (10%) patients.

Table7: Various complications encountered post-operatively.

Complication	No. of patients	Percentage
Nil	22	73.30%
Partial flap necrosis	05	16.70%
Dehiscence	02	6.7%
Donor site morbidity	01	3.3%

Of the 30 flaps, 5 (16.7%) flaps had partial flap necrosis, 2(6.7%) flaps had flap dehiscence and 1 (3.3%) flap had donor site SSG partial loss.

DISCUSSION:

This prospective clinical study includes Twenty eight (28) patients with defects of distal forearm and hand due to trauma and electrical burns and tumours admitted in the department of Plastic and Reconstructive surgery, Osmania General Hospital, and MNJIO & RCC, Hyderabad, Telangana, admitted from December 2019 to November 2021. Two patients had 2 flaps done. So, total 28 patients 30 flaps are included in the study.

The common age group in our study was 21 - 40 years, with the age of the patients ranged from 10- 60 years. This might be because young people in this group are involved in various work fields, especially in electricity related work. This is similar to the study by Ahmed Ali⁴ the age of the patients ranged from 17-46 years. Similarly, in the study by Muhammad Shahzad², the common age group was 21-30 years. Age range in the study by M. Meky⁶ was 14-46 years. In the study by Dietma Ulrich⁷ also patient's age ranged from 9 to 55 years. Present study results are comparable with the results of these studies.

In this study, most common cause of injury was electrical burn injury (46.4%) followed by road traffic accidents (25%), work related injury (14.3 %), tumors (7.1) and one patient each with suicidal injury. The causes of Electrical burn injuries were work related, domestic accidents and in children while playing kites. However, road traffic accidents (46%) was the commonest cause of hand injury in the study by Muhammad Shahzad et al.⁵ While in the study by Wael Ayad⁸, crush injury (57.14%) was found to be the commonest cause of hand injury. Haitham Mohammed⁹ (39.7%) and Jimmy Chow et al¹⁰ (37.5%) also reported crush injury as the most common cause. Ghosh et al¹¹ found Machinery injury (58.82%) being the commonest cause of hand injury

In the present study, size of defect ranged from 6 to 16 cms (longest dimension). Maximum defects 18 (60%) are within 7 – 10 cms , 10

(33.3%) defects are > 10 cms and 2(6.7%) defects are < 7 cms. For larger defects, combined groin and hypogastric flaps are done. Hand injuries are of three main types; cutting and slicing, crushing, degloving and avulsion. The injuries may be of a variable combination of skin, soft tissues, tendons, nerves, blood vessels and bone damage. When bones and tendons are exposed for a long time they become dried, desiccated, infected and ultimately destroyed with loss of function. All these can easily be prevented by covering the exposed bones and tendons with a flap. As the hand performs unique mechanical function, it is imperative to provide good soft tissue coverage of the hand. Skin graft when used may cause wound contraction. All flaps include the entire thickness of skin and subcutaneous tissue along with their own blood supply. So they provide better and durable skin and soft tissue coverage. They also provide subcutaneous fat through which tendons can glide. There is chance of minimum wound contraction as there is no myofibroblasts within the flap. The upper limb can tolerate delayed reconstruction but the hand will not endure due the consequential joint stiffness and tendon adhesions.

In this series, superiorly based abdominal flaps done in 9 (30%) patients, inferiorly based abdominal flaps done in 3 (10%) patients, groin flaps done in 8 (26.7%) patients, hypogastric flaps done in 7 (23.3%) patients and combined groin & hypogastric flaps done in 3 (10%) patients.

Superiorly based abdominal flaps are usually done for defects on wrist & ventral forearm as well as on dorsum of hand and forearm. Inferiorly based abdominal flaps done only for defects on dorsum of hand and forearm whereas groin flaps done for defects on both dorsal and ventral side. In 2 patients, tendon repairs were done along with flap cover. In one patient, iliac bone grafting done for lost 1st metacarpal along with flap cover. For groin flaps, donor area is primarily covered whereas for other flaps, grafting is done.

1) Superiorly based abdominal flap



2) Inferiorly based abdominal flap



3) Tendon repair done and groin flap



4) Hypogastric flap



5) Combined groin and hypogastric flap



6) 2 superiorly based abdomen flaps



7) 1st metacarpal bone was lost. Iliac bone graft was taken from right side replaced the 1st metacarpal. Groin flap was done.



CONCLUSION

This study concludes that the hand and forearm defects are more common in males. Young and middle aged were the commonly affected group than the children and old. The most common cause for hand injuries is electrical injuries followed by road traffic accidents. Most common injuries are on wrist and dorsum of hand on right side. Most of patients presented within 24 hours of injury. In this study

major reconstructions were done as primary procedure whereas secondary reconstruction was chosen for electrical injuries after serial debridement. Superiorly based abdominal flaps and groin flaps were the major flaps done to cover the dorsal defects of hand as well as palmar defects of wrist and distal forearm and inferiorly based abdominal flaps and hypogastric flaps for defects of dorsum of hand and forearm. Other additional procedures like disarticulation, k – wire fixation, SSG, tendon repair, bone grafting etc. are done without major complications. Complication rate was relatively less and very minimal in this study. Functional restoration is achieved to the maximum and its aesthetic appearance was good. Duration of hospital stay depended on the cause of injury. We conclude that abdominal flaps have significant role in reconstruction and restoration of hand function and it can be considered as the one of the best options for reconstruction of hand and distal forearm defects.

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