Outcome of the Pedicled Superficial Inferior Epigastric Artery (SIEA) Flap for Coverage of the Hand & Forearm Defects

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Abstract:

Background:
Soft tissue defect of the hand & forearm after trauma are always a challenge to reconstructive surgeon. Different reconstructive methods have been used to manage this defect considering the functional & aesthetic outcome. Among the distant flap SIEA has some unique advantages as a fasciocutaneous flap. The vascular anatomy is relatively constant; it covers a large area of defect with direct closure of donor site in a linear fashion. It is an axial pattern flap & chance of flap necrosis is less. Moreover it has an arc of rotation of about 120^0 which favor the coverage of both palmer & dorsal aspect of hand and forearm. It is easy to harvest and position of hand can be maintained comfortably. So SIEA flap is a useful option for coverage of soft tissue defect of hand and forearm.

Aim:
To evaluate the clinical outcome of the superficial inferior Epigastric artery (SIEA) flap to cover the soft tissue defect of the hand and forearm.

Methods:
This was a prospective observational study carried out on 50 patients with soft tissue defect of the hand and forearm who presented between the periods of June2014 to May 2015 in the department of plastic surgery of Dhaka medical college hospital, Dhaka. Detailed history was taken from the patient and their attendants in each case. The wounds were examined preoperatively also per-operatively to assess the nature of trauma, to examine the exposed structures and in all patients resurfacing were done with SIEA flap. Clinical photographs were taken in all cases both preoperatively, peroperatively and postoperatively.

Results:
A total 50 patients were operated. The age range was 15 – 60 years, among them 72% patient were in the age range of 26 – 35 years. 78% patients in this series were male. In this series 56% patient sustained hand trauma from electric burn and 24% patient from machinery injury. In this series 68% patient have injury in right hand and 31 patients (62%) had wound over the dorsum of the hand. In this study showed that in context to the length and breadth of the wound, majority (32%) of the patients had a wound dimension of 101 – 125 cm2. The smallest wound dimension was 10 x 5 = 50 cm2 and largest wound dimension was 18 x 10 = 180 cm2, indicating that extent of soft tissue defects in this series is quite extensive.. In this study 41 (82%) patient had no flap loss, 7 patients had marginal flap loss and only 2 patients had a partial flap loss. None of the patient had flap loss more than 5% of total length. Among 50 patients 39 (78%) patient had good result and (11%) 22% showed acceptable result. In 35 (70%) cases donor site had closed directly and 30 % patient needed STSG.

Conclusion:
SIEA flap is a good choice for resurfacing the hand and forearm injury with acceptable result.

Key words: Hand and forearm defect, Superficial inferior Epigastric artery (SIEA) flap, Axial pattern flap.

Introduction:

Reconstruction of the soft tissue defect of the hand and forearm remains a challenge for the plastic and reconstructive surgeons[1]. Defect of the hand as well as defect of the forearm can be covered by local, regional, distant or free flap. For

larger defect a local or regional flap may not be available. In that case a distant or free flap is the option of reconstruction. Free flaps are single stage procedure with a marked flexibility in size, shape and positioning. Free flap coverage requires well supported and organized microsurgical service, infrastructure, expertise and good post-operative facility[2,3,4]. The flap based on superficial inferior Epigastric artery (SIEA) was first described in 1946 by Shaw and Pyne[5]. It also provides sufficient length and breadth required for resurfacing the dorsum and palmer aspect of the hand. The hand can be placed in a comfortable position without causing discomfort to the shoulder, elbow and wrist joint. The versatility in positioning and direct closure of donor site in a linear fashion make the SIEA flap unique for the coverage of hand and forearm defects[6].

In this study soft tissue defect of the hand and forearm were covered with superficial inferior Epigastric artery (SIEA) flap and clinical outcome were evaluated.

Methods:

The study was a prospective observational study conducted in the Department of Plastic Surgery, Dhaka Medical College and Hospital, Dhaka, from June` 2014 to May` 2015 (12 months). 50 patients with soft tissue defect of hand and forearm defects were selected to cover the defect with superficial inferior epigastric artery flap who fulfilled the enrolment criteria from the study population. Purposive sampling technique was used.

Operative Technique:

Under general anesthesia the wound excision was done and fashioned it for flap design. Then according to the measurement, the superficial inferior Epigastric artery [SIEA] flap is outlined with indelible ink on the lower abdomen prior to elevation. The superficial inferior Epigastric artery is located approximately 6 cm lateral to the pubic tubercle along a line joining the pubic tubercle with anterior superior iliac spine7.

This vessel originates from the common femoral artery and is accompanied by a vein of similar size. A prominent superficial inferior Epigastric vein sometimes is visible through the skin of anterior abdominal wall. The position of this vein is a helpful clue to the location of associated artery[8]. The vascular pedicle consisting of the superficial inferior Epigastric artery and vein can provide blood supply and venous drainage to an area of skin that include the entire ipsilateral and much of the contra lateral hypo gastric regions. The greatest dimensions of *SIEA* flap are 25cm in length and 15cm in width[9]. The flap can be designed to cross the midline. A variable amount of skin and subcutaneous tissue on the contra lateral side will survive, based on respective superficial inferior Epigastric vessels[10]. After outlining the proposed flap, the inferior incision is made through the skin, superficial subcutaneous layer, and Scarpa's fascia. The vascular pedicle is identified and the superficial inferior Epigastric artery and vein are preserved. Dissection was carried out under loup magnification The lateral and superior incision are completed to the level of external oblique fascia, from which entire flap can be elevated. After meticulous hemostasis, the donor site is closed directly in a straight line.

The SIEA flap can be rotated through an arc of at least 90 degrees. Then flap is thinned to the level of the Scarpa's fascia in the region of the vascular pedicle (Figure-1). Scarpa`s fascia is a thin delicate membranous layer under the prominent fatty (Campar`s fascia) layer.

The flap is kept for three weeks and there after division done. After flap division to prevent stiffness of the wrist joint post-operative early physiotherapy is given.

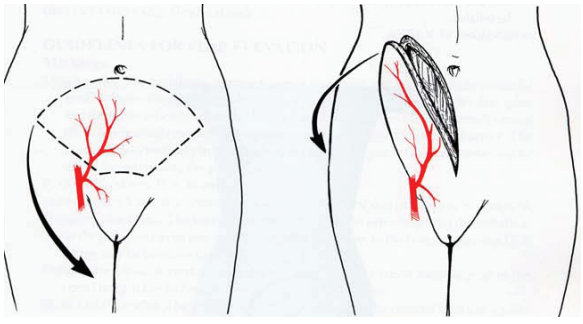


Figure-1: Flap Design (Mathes and Nahai page no.-1099)

Results:

This is a prospective observational study carried out on 50 patients with soft tissue defect of the hand and forearm in the department of plastic surgery, Dhaka medical college hospital, Dhaka. All the patients were treated with definitive surgery to resurface the soft tissue defect with

SIEA flap. There was no patient who did not agree to participate in the study after counseling.

Table-I: Distribution of the patients by age

Age in years	Frequency	% of total patient
15 – 25 year	07	14%
26 – 35 year	37	74%
36 – 45 year	04	10%
> 46 year	02	04%
Total	50	100%

In the study, the age range was 15-60 years .Majority (74%) of the patients belongs the age group 26- 35 years. This reflect that hand injury are much more prevalent who are young & active.

Table-II: Distribution of the patients by sex

Sex	No of patient	% of total patient
Male	39	78%
Female	11	22%
Total	50	100%

The table showed majority (78%) of the patients were male reflecting that male were more commonly predisposed to hand trauma. This is probably due to outside work are mostly done by male worker.

Table-III: Etiology of soft tissue defect of hand & Forearm

Cause	No. of patient	% of total patient
Electric burn	28	56%
Mechanical injury	12	24%
Road traffic accident	07	14%
Flame burn	03	06%

In this study most of the patients (56%) were injured by electric burn. This is probably due to less use of personal protective equipments.

Table-IV: Site of the wound

Site of the wound	No. of patient	% of total patient
Dorsum of the hand	33	66%
Extensor surface of the forearm	12	24%
Flexor surface of the forearm	05	10%

This table showed that majority (66%) of the patient of this series hand injury over the dorsum of the hand.

Table-V: Side of involvement.

Hand	No. Patient	% of total patient
Right	34	68%
Left	16	32%

The table showed that majority (68%) of the patients of this series right hand was more commonly affected than left one. This was probably due to the fact that right hand is dominant in all patients.

Table-VI: Wound dimension (Length X Width)

Wound dimension	Frequency	Percentage (%)
50 – 75	07	14%
76 – 100	11	22%
101 – 125	21	42%
126 – 150	07	14%
151 – 175	03	06%
176 - 200	01	02%

This table showed that majority (42%) of the patients had a wound dimension of 101 – 125 cm2. The smallest wound dimension was 10x5 = 50 cm2 and the largest wound dimension was 18 x 10 = 180 cm2. This indicate that extent of soft tissue defect in this series were quite extensive.

Table-VII: Flap dimension (Length X Width) cm^2

Flap Dimension	Frequency	Percentage (%)
50 - 75	07	14%
76 – 100	09	18%
101 – 125	19	38%
126 – 150	10	20%
151 – 175	03	06%
176 – 200	02	04%
Total	50	100

This table showed that majority (38%) of the patients needed a Flap dimension was 101–125 cm2. The smallest flap dimension was 11x5= 55 cm2 and the largest most flap dimension was 19x10= 190 cm2. Width of the wound was same as width of the flap but length of the flap was 1 cm more required than length of the wound for tensionless closure.

Table-VIII: Status of flap adhesion Status No.

Status	No. patient	% of total patient
Partial flap adhesion	07	14%
Total flap adhesion	43	86%

This table showaed that 86% of the patient had total flap adhesion. The duration was 21 days.

Table-IX: Outcome of flap. (n=50)

Outcome	No. of patient	% of total patient
Complete flap survival/ no loss of flap	41	82%
Marginal flap loss	06	12%
Partial flap loss up to 5% of flap length	03	06%
Major flap loss >5% of flap length	Nil	0.0%

This table showed that 82% of patients had complete flap survival. Marginal flap loss 12% and flap loss up to 5% of flap length was 6%.

Table-X : Result of reconstruction (n=50)

Result	No. patient	% of total patient
Good	39	78%
Acceptable	11	22%
Poor	00	Nil

This table shows that 78% of the patients had good result and 22% patients have acceptable result. There was no poor result in this study.

Table-XI: Donor site management. (n=50)

Coverage	No. of patient	% of total patient
Direct closure	35	70%
STSG	15	30%

This table showed that in 70% of the cases donor site was closed directly,

Table-XII: Management of complication of Flap. (n=9)

Management	No. of patient	Percentage
Debridement & coverage with STSG	03	33.33%
Advancement of previous flap	04	44.44%
Conservative	02	22.22%

This table showed that 3 patients (33.33%) needed debridement of the flap & coverage of the defect with STSG. Another 4 cases was managed by advancement of previous flap. 2 cases managed conservatively.

Table-XIII: Donor site morbidity

Morbidity	No. of patient	% of total patients
Wound infection	07	14%
Wound dehiscence	05	10%

This table showed 12 patient developed donor site morbidity, out of these 7 patients (14%) developed wound infection and 5 patients (10%) had wound dehiscence.

Table-XIV: Outcome of the flap (At different period of follow up) (n=50)

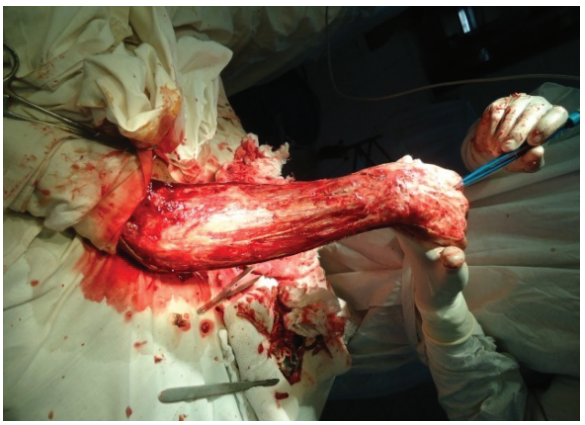
Outcome of flap	At 6^{th} week	At 8^{th} week	At 12^{th} week
Good	42 (84%)	42 (84%)	42 (84%)
Acceptable	08 (16%)	08 (16%)	08(16%)
Poor	00	00	00
Total	50(100%)	50(100%)	50(100%)

This table showed that outcome of SIEA flap is good and acceptable in all cases.

Discussion:

Among the distant flaps the Superficial Inferior Epigastric Artery (SIEA) flap, is an axial pattern flap can cover a larger defect of various dimensions (greatest 25X15cm) with direct closure of donor site leaving a scar in linear fashion[11]. In present series fifty patients with soft tissue defect of hand & forearm were treated by resurfacing the wound with SIEA flap. The patients were selected from the department of plastic surgery, Dhaka medical college hospital, Dhaka, according to inclusion & exclusion criteria from June `2014 to may2015. The patients underwent operative procedures as mentioned in methods. The patients were given standard preoperative and post operative management. The age range was 15 to 60 years among them 74% patients were in the age range 26 to 35. This reflect that hand injury are much more prevalent who are young & active (Table-I). Ye-Yang et al.[12] conducted a study where average age of the patients was 24.8 years, which is near to mean age of this study. 76% of the patients in this series were male reflecting that male was more commonly predisposed to hand trauma (Table-II). Another study carried out by Kimura N. et al.[13] where 30 patient were studied, among them 21 patients (70%)

PHOTOGRAPHS

Before and after wound excision



Flap insetting



After flap division



After flap division (donor site)

were male and 9 patients(30%) were female. The sex distribution is similar to the present study. In this study most of the hand & forearm defect was due to electric burn which is 56% followed by machinery injury (24%) and only 14% patient had RTA. Kamruzzaman M[14] shows in his dissertation which was conducted in plastic surgery department of Dhaka medical college hospital that 54% of the total patient sustained hand injury from electric burn and 26% from machinery injury & 12% from RTA. These are similar to the present study. In both study electrical burn is the predominant cause of the hand injury (Table-III). Kalam A.et al.[15] conducted a study where 60% of the patients had their hand defects on the dorsum of the hand. Among 50 patients in this series 33 patients (66%) had wound over the dorsum of hand which is near similar to that study. In both study majority of the patient had suffered from electric burn; dorsum of the hand was the common site of involvement (Table-IV). Electric burn might involve multiple site, Patient with wound over dorsum of hand and forearm were included in this study. Majority (68%) of the patients of this series injury of right hand was more common than left hand. This is probably due to the fact that right hand is dominant in all patients (Table-V). Kamruzzaman M[14] conducted a study where 60 cases were taken. He showed majority (28.33%) of the patients had a wound dimension of 101 – 125 cm2. In this study 42% of the patient had wound dimension of 101 – 125 cm2. In both study majority of the patients had a wound dimension of 101-125 cm2.The smallest wound dimension was 10x5= 50 cm2 and largest wound dimension was 18x10= 180 cm2 (Table-VI). This is similar in both studies. This indicate that extent of soft tissue defect in this series were quite extensive. For coverage of such defect that majority (38%) of the patients needed a flap dimension was 101 – 125 cm2. The smallest flap dimension was 11x5 = 55 cm2 and the largest flap dimension was 19x10=190 cm2 (Table-VII). This is also similar in both studies. Width of the flap was same as the width of the wound but the length of the flap was 1 cm larger than the length of the wound for tension less closure. Stevenson T R et al.[6] concluded in their study that greatest dimension of SIEA flap were 25 cm in length and 15 cm in width. SIEA flaps harvested in this study were below this dimension. This study showed 41 patients (82%) had complete flap survival with no flap loss, whereas 6 patients (12%) had marginal flap loss. In 3 patients (6%) had partial flap loss (Table-IX). A study conducted by Kalam M et al.[15] where 80% of patients have no flap loss and 20% cases with apical flap necrosis which is near similar to this study. This study favorably comparable to the study carried out by Mih AD[16] who has shown terminal flap necrosis of about 15% in his series. There was no total flap loss in this study due to its reliable pedicle. Result of resurfacing of hand & forearm injury with SIEA flap were categorized as good, acceptable and poor on the basis of (a) Extent of loss of flap (b) Flap adhesion (c) Whether flap loss were salvageable or not. Nasir S[17] showed 73% of good outcome with SIEA flap. Depending on above criteria, in this study 78% patient had good out come and 22% patients have acceptable outcome (Table-X). So the resurfacing of the hand & forearm injury with SIEA flap gives a very good result. Regarding donor site management, 35 patients (70%) had primary closure of donor site and 15 patients (30%) required STSG (Table-XI). Yilmaz S et al.[9] achieved primary closure of donor site in 91% cases and 9% cases needed STSG for donor site. Regarding management of complication flap, 9 patients developed complication. Out of this 3 patient needed debridement & STSG. In 4 patients wound were covered with advancement of previous flap and rest 2 patients managed conservatively (Table-XII). Huang et al.[18] showed in their study, donor site required STSG in 30% cases, wound dehiscence occurred in 17.5% cases. In the present study 30% of total study population required STSG, wound dehiscence was occurred in 10% cases. It is near similar to study done by Parrett B.M et al. study (Table-XIII). In this study all patients were attend follow up at a regular interval and taken physiotherapy also at that time. None of the patient had any donor site morbidity other than some patients had ugly scar due to STSG (Table-XIV). So the overall outcome of the SIEA flap in this study is good and is comparable with other studies.

Conclusion:

SIEA flap is a good option for resurfacing the soft tissue defect of the hand and forearm with acceptable result. The flap has a predictable and constant vascular anatomy and less donor site morbidity. So it is a reliable and versatile flap for hand & forearm coverage where facilities for doing a free flap is yet

to be available.

Limitations:

1. Sample size was small. Only 50 patients were taken for study which may not represent the whole population.
2. Random sampling was not followed.
3. The period of follow up was only 3 months which was very short in respect to draw substantial conclusion about functional outcome and aesthetic outcome.
4. More detailed aesthetic and functional consideration of coverage has not been taken in account.

References:

1. Shamsuzzaman M, Borhanuddin SK, Masoom M, Islam MA, Haque A; Groin flap: A good converge for hand injury, J Medicine. 2006;7:15-19.
2. Mc Gregor A.D, Mc Gregor JA; Fundamental technique of plastic surgery, 10th ed; Churchill living stone, London. 2000;183-213.
3. Thorne CH. Techniques and Principles in Plastic Surgery. In: Thorne CH, Beasley RW, Aston SJ, Bartlett SP, Gurtner GC, Spear SL, editors. Grabb and Smith's Plastic Surgery, 6th edition, Philadelphia, Lippincott Williams and Wilkins, 2007;14.
4. Chen HC, Tang YB, Mardini S and Tsai BW. Reconstruction of the hand and upper limb with free flaps based on musculocutaneous perforators. Microsurgery, 2004;24:270.
5. Parrett BM, Bou-Merhi JS, Buntic RF, Safa B, Brooks Darrel. Refining Outcomes in Dorsal Hand Coverage: Consideration of Aesthetics and Donor site Morbidity. Journal of Plastic & Reconstructive Surgery November. 2010;125(5):1630-1638.
6. Stevenson TR, Hester TR, Duus EC, Dingman RO. The superficial Inferior Epigastric artery Flap for Coverage of Hand and forearm Defects. Annals of Plastic Surgery. 1984;12(4):333-339
7. Mathes SJ, Nahai F. Reconstructive Surgery: Principles, anatomy and Technique. 1st ed. New York: Churchill Livigstone; 1997;759-773.
8. Shaw DT, Payne RL: One-stage tubed abdominal flaps. Surg Gynecol Obstet. 1946, 83:205.
9. Yilmaz S, Saydam M, Seven E and Ercocen AR. Paraumbilical perforator-based pedicled abdominal flap for extensive soft-tissue deficiencies of the forearm and hand. Ann. Plast. Surg. 2005, 54; 365-368
10. Carty MJ, Taghinia A, Upton J. Fascial Flap Reconstruction of the Hand: A Single Surgeon's 30- Year Experience. Journal of Plastic and Reconstructive Surgery. 2010;125(3):953-962.
11. Ali A, Farag M and Safe K. Reconstruction of Hand and Forearm Defects by Abdominal Thin Skin Flaps. Egypt, J. Plast. Reconstr. Surg. 2007, Vol. 31, No. 2, July: 181-185.
12. Ye-Yang LI, Jin-Lun Wang, Ye Lu, Jun Huang. Resurfacing deep wound of upper extremities with pedicled groin flaps. Department of burns and Plastic surgery, Guangzhou Red Cross Hospital, 396 Tongfu Road, Central Guangzhou, People`s republic of china. Accepted 21 July 1999.
13. Kimura N, Saitoh M, Hasumi T. Microdissected thin groin flap transfer operation. Journal of Plastic and Reconstructive Surgery. 2008;119(6):953-962.
14. Kamruzzaman M. Resurfacing of Soft tissue defect on hand following injury with groin flap – An analysis of thirty cases, FCPS (Plastic & Reconstructive Surgery) Dissertation, Bangladesh College of physician and Surgeon, Dhaka, Bangladesh, 2014.
15. Kalam MA, Khundakar SH. Groin Flap: An Important Arrangement for Resurfacing of the Hand. The Journal of Bangladesh Orthopedic Society. 2001;18:7-12.
16. Mih AD. Pedicle flaps for coverage of wrist and hand. Hand Clin. 1997; 13:217-219.
17. Nasir S. and Aydin M.A. Wide Combined Thin Free SCIA/SIEA Flap. Ann Plast Surg 2008;61:627-631.
18. Huang Dong, Wang Hai-Wen, Wang Hong-Gang, Wu Wei-Zhi And Zhao Cheng-Yi. Reconstruction of soft tissue defect of the extremity with the perforator flap from inguinal region. Chinese Medical Journal, 2009; 122(23), 861-864.