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ISLAND FLAP; ROLE OF SUPRACLAVICULAR ARTERY ISLAND FLAP IN COMPLEX FACIAL SOFT TISSUE RECONSTRUCTION: A CLINICAL STUDY

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ABSTRACT... Objectives: To determine the role of Supraclavicular Artery Island Flap as an alternate to local and other regional flaps for complex soft tissue reconstruction of head and neck defects created by tumor resection, fire arm injuries, and burns. **Study Design:** A descriptive clinical experimental study. **Place and Duration of Study:** From December 2014 to November 2017, at Department of Plastic & Reconstructive Surgery, Dow University of Health Sciences and Dr. Ruth KM Pfau, Civil Hospital Karachi, Pakistan. **Methodology:** Pedicle supraclavicular artery island flap was used to reconstruct facial soft tissue defects. Recipient and donor site outcomes, functional consequences and complications were assessed. Patients with soft tissue defects either due to tumor extirpation and supraomohyoid neck dissection, trauma due to firearm arm and burn were included. Patients with level IV neck dissection or having scarred or injured supraclavicular areas were excluded. **Results:** Eighty-Four Supraclavicular Artery Island flap reconstructions were performed for the reconstruction of lower face defects. Mean age of patients was 40.7 years. Through-and-through defect involving the oral lining and skin of the lower face after tumor excision in 78 cases, fire arm injury and burn was the cause in 3 patients each. Complete flap failure was 3 (3.5%) and partial flap failure was in 6 (7.1%) patients. Mean period of follow-up was 11.86 months (range 7-19 months). **Conclusion:** Supraclavicular Artery Island Flap is an excellent alternate to other local and regional flaps with impressive recovery, acceptable skin color match and restoration of anatomic function at recipient site without any serious complications. Majority of donor sites were closed primarily, and healed without any major complications.

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Key words: Supraclavicular Flap, Head & Neck Tumor, Firearm, Burn, Complex Reconstruction.

Article Citation: Ali H, Noor ul Wahab, Ahmed S, Saeed ul Khair H, Pervaiz M, Ali SM, Rao MH, Ganatra MA. Island flap; role of supraclavicular artery island flap in complex facial soft tissue reconstruction: a clinical study. Professional Med J 2018; 25(9):1287-1295. DOI:10.29309/TPMJ/18.4512

Article received on:

14/11/2017

Accepted for publication:

25/05/2018

Received after proof reading:

00/00/2018

INTRODUCTION

Complex reconstruction of facial soft tissue defects after tumor resection, firearm injuries and burns remain one of the most challenging aspects of facial region. The aim of facial reconstruction is not only to conceal the defect created by the surgery, but also to reestablish anatomical function and to match skin color and aesthetics at the recipient site.¹ Local flaps are usually insufficient in volume, whereas other regional flaps (e.g. deltopectoral, pectoralis major latissimus and trapezius flaps) have greater bulk and have greater donor site morbidity² from

a functional and aesthetic perspective. They also provide a poor skin color match when used for skin resurfacing.³ The use of micro-vascular free-flaps for head and neck reconstruction has increased the available options. These flaps are versatile and offer well-vascularized soft tissue pedicles to head and neck defects that usually decreased vascularity, especially after undergoing radiotherapy. Nonetheless, they require extended operative time, thorough postoperative monitoring, and specialized equipment that might not be accessible in all centers.³

In 1842, Mütter was the first author to describe random pattern medial-based shoulder flaps in reconstruction of head and neck defects.⁴ The Acromial Flap or shoulder fasciocutaneous flap was primarily termed as a random pattern flap by Kazanjian and Converse in 1949.⁵ In 1978, Vasconez and Mathes examined the blood supply of the shoulder region and termed it the 'cervicohumeral' flap.⁶ In 1979, Lamberty described the supraclavicular pedicle as an axial patterned flap.⁷ Blevins PK and Luce EA, in 1980, observed distal flap necrosis while using the cervicohumeral flap.⁸ A clinical series was published by Pallua N. for post-burn neck contractures^{9,10,11,12}, and in 2000 he also described his first reconstruction of head and neck oncologic defects with Supraclavicular Artery Island flap.¹⁰ In 2005, Di Benedetto et al. described Supraclavicular flap as trustworthy for covering and lining of oral soft tissues after tumor resection.¹³

Supraclavicular Artery Island Flap is safe and suitable regional fasciocutaneous flap for soft tissue reconstruction of facial defects. The flap is easy to harvest with minimal donor site morbidity¹⁴ due to the natural elasticity of skin in the supraclavicular region.¹⁵ It has gained wide acceptance as an ideal flap for reconstruction of head and neck soft tissue defects and matches the flexibility, color and delicacy of the head and neck area. Additionally, the skin over this region is devoid of hair and it has superior results when compared to the free grafts from arm, thigh or abdomen.¹⁶

METHODOLOGY

Study Duration

From December 2014 to November 2017.

Inclusion criteria

All the patients presented with T3 and T4 cancer according to American Joint Committee on Cancer (AJCC) staging of head and neck cancers going through supraomohyoid neck dissection, patients having lower face defects due to trauma and burns were selected for this study.

Exclusion Criteria

Patients going through extended neck dissection (beyond level III) or patients having distorted anatomy of lower neck region due to previous surgeries or patients having scars on shoulder area were excluded from our study.

Sample Size

84 patients were recruited in our study fulfilling the inclusion criteria and given written consent.

Settings/Places

All surgeries were performed at Department of Plastic & Reconstructive Surgery, Dow University of Health Sciences & Dr. Ruth KM Pfau, Civil Hospital Karachi. Reconstructed site and donor site outcomes and complications were evaluated through follow-up.

Data Analysis

Percentage were calculated and recorded through IBM SPSS version 23.

Surgical Technique

The Supraclavicular Artery Island flap is harvested as formerly described.^{9,13,3,17} The patient is placed in a supine position; a portable Doppler ultrasound probe is used to locate the supraclavicular artery in the triangle created medially by the posterior margin of the sternocleidomastoid muscle, inferiorly by the clavicle and laterally by the external jugular vein (Figure-1). A Doppler is used to outline the acromion and the supraclavicular artery, where it emerges from transverse cervical artery. This point is used as the arc of rotation of the flap and to determine the length of the flap. The supraclavicular flap is then outlined with a twenty to twenty six centimeters length from the fulcrum point and six to seven centimeters width to permit primary closure. While closing the donor site, dog-ear deformity can be avoided by modifying the length of the flap.

The longer axis of the supraclavicular artery island flap is placed between a posterior line on the border of trapezius muscle and an anterior line that is parallel to the posterior part till the deltoid. The Supraclavicular flap is garnered from lateral area to medial region, with a mono-

polar electrocautery at the subfacial plain off the deltoid muscle. Despite few perforating vessels from the posterior circumflex humeral artery and deltoid muscle that are either ligated or cauterized, a simple dissection is typically done, till the supraclavicular fossa. Anteriorly the supraclavicular flap is elevated up to the clavicular region, and then the flap is dissected cautiously with a bi-polar electrocautery as soon as the acromion is reached. An ultrasound Doppler probe is used to recognize the supraclavicular artery. Level V lymph nodes and fat must also be dissected and mobilized around the supraclavicular artery to attain a greater arc of rotation; it is carried out at a subfacial plain to guard the pedicle.

To farther increase the length of the flap past the supraclavicular artery, ligation or cauterization of the distal transverse cervical artery can be carried out and the vascular pedicle may be mobilized up to the thyrocervical trunk. Extra amount of proximal skin pedicle is de-epithelialized by the help of a scalpel or with needle tip electrocautery, and placed into the defect. By cutting the skin on the distal end to check for bleeding is a useful method to assess the vascularity of the flap. If the vascularity at the distal tip of the flap is not satisfactory, the flap may be cut down till the adequate bleeding is observed. The donor-site is closed primarily over a drain after extensive undermining off surrounding tissues.

The defect site and neck are also typically closed over a drain. Deep to the sternocleidomastoid muscle in the posterior triangle of the neck, accessory nerve is present and innervates the trapezius muscle; hence it rests beneath the supraclavicular flap and its pedicle.¹⁸ Though it rests in deeper tissue planes, dissection must be kept at a subfacial level, to avoid damage to this nerve.

RESULTS

Total of 84 cases, fulfilling the inclusion criteria and given required consent were included in the study. The mean age of the patient was 40.7 years. Most of them (30 cases i.e. 35.8%) were in the age group 30-40. Majority (81 cases i.e. 96.4%) were

male whereas only 3 case of female. Majority (54 patients i.e. 64.3%) were reconstructed for cheek defects, followed by lower lip (15patient's i.e. 17.8%) and upper lip (6patient's i.e.7.1%).

Supraclavicular Artery Island flaps provided a dependable reconstruction option for lower face defects created by oncologic resection (78 cases i.e.92.8%), fire arm injury (3 case i.e. 3.6%), and burn (3 case i.e. 3.6%). Cause of defect in 78 (92.8%) was tumor extirpation and in 3 (3.6%) patient with fire arm injury and 3 (3.6%) patient with burn injury. Seventy eight (92.85%) flaps were folded on themselves to reconstruct through-and-through defects (internal 'lining' and external 'covering'). In 6 (7.15%) cases in which external covering was provided by this flap; there was soft tissue loss due to fire arm injury and burn. Out of these 84 cases, 3 (3.6%) was complete flap necrosis due to over stretching of the flap which led to occlusion of the pedicle and 6 (7.1%) partial flap necrosis occurred. Donor site was closed primarily in 69 (82.15%) patients, while split thickness skin graft (SSG) was applied in fifteen (17.85%) patients. Wound dehiscence of six out of 69 (8.7%) primarily closed donor site occurred, due to excessive tension at the approximated edges and it was managed by general wound care until completely healed (Figure-2, 3 & 4).

Follow-up was done from 7 months to 19 months (mean 11.86 months). Results proved that Supraclavicular artery island flap proved ideal for this situation, providing adequate amount of tissue with excellent aesthetic results. (Table-I A & I B).

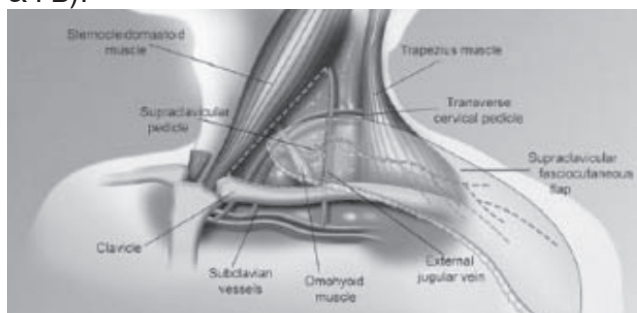


Figure-1 The supraclavicular pedicle emerges from transverse cervical vessel and is located in the triangle formed by the dorsal edge of the sternocleidomastoid muscle, the external aesthetic surgery (2012)65, 1350-1356



Figure-2. A 45 year old male patient presented with a swelling in submandibular region (a). Biopsy was done and squamous cell carcinoma of sub-mandibular gland was confirmed. Excision of tumor with level III neck dissection was performed (b). A defect size of 8 cm*7 cm was created which was reconstructed by a supraclavicular artery island flap, where size of the pedicle was 9 cm x 7 cm (c). After 2 months follow up (d).

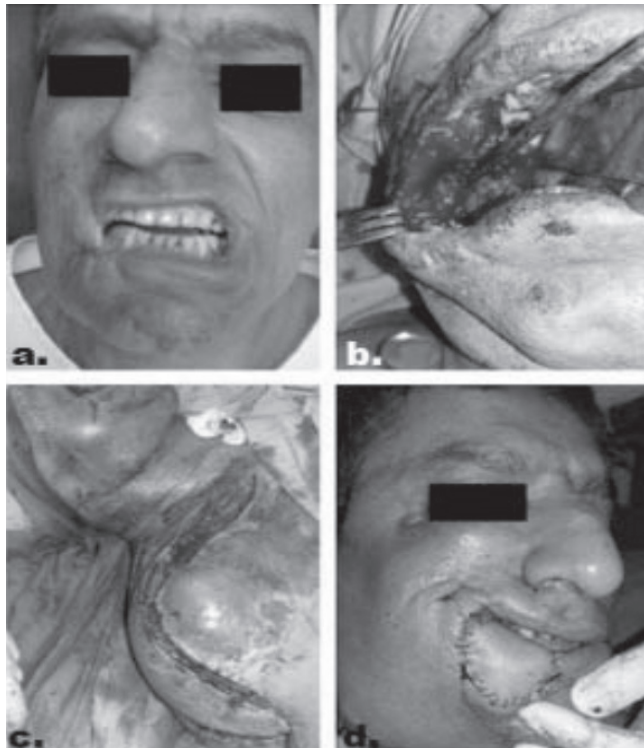


Figure-3. A 41 year old male patient presented with squamous cell carcinoma of lower lip(a). A defect size of 5 cm x 4 cm was created (b) which was reconstructed by a supraclavicular artery island flap, where size of the pedicle was 5 cm x 7 cm (c)(d).



Figure-4. 50 year old male with SCC of lower lip and reconstruction with supraclavicular flap done. Preoperative and postoperative images.

DISCUSSION

In the modern period of head and neck reconstruction, micro-vascular free flaps have become the gold standard, as the radial forearm free flap and anterolateral thigh free flap being widely used. Free-tissue grafting is reliable but involves technical expertise and takes longer to operate. On the other hand, regional flaps, like the pectoralis major flap, are dependable and take lesser time to operate. Nonetheless, the pectoralis major myocutaneous flap is usually bulky and offers a poor skin color match. As this flap is smaller in size, it is not preferred for larger defects.

The Supraclavicular Artery Island flap is hairless, thin and its color is similar to those of the face. The thinness of the dermis permits for suitable adaptation on the suture line and the lack of hair make it suitable for reconstruction of oral cavity lining defects. Its fulcrum is positioned closer to the facial region than the deltopectoral and pectoralis major flaps, theoretically offering an improved arc of rotation.

Some authors consider supraclavicular artery

Variables		Frequency	Percentage
Age	<30 years	15	17.8
	31-40 years	30	35.8
	41-50 years	18	21.4
	>50 years	21	25.0
Gender	Male	81	96.4
	Female	3	3.6
Diagnosis	Cheek	54	64.3
	Lower Lip	15	17.8
	Upper Lip	6	7.1
	Burn injury	3	3.6
	Fire arm injury	3	3.6
	Submandibular gland	3	3.6
Level of Dissection	Level III	78	92.9
	Not done	6	7.1
Complications	None	75	89.3
	Partial flap necrosis	6	7.1
	Complete necrosis	3	3.6
Donor site closure	Primary	69	82.1
	Skin grafting	15	17.9
Follow-up	0-12 months	54	64.3
	13-24 months	30	35.7

Table-I (A). Demographic and clinical data of the participants

Case No	Age of the patient (years)	Sex	Diagnosis	Defect size (cm)	Level of neck dissection	Flap size (cm)	Complication	Donor side closure	Follow-up period
1	44	F	SCC(Cheek)	7x6	Level III	8x9	None	Skin graft	07
2	39	M	SCC(Cheek)	8x9	Level III	9x11	None	Primary	11
3	37	M	SCC(Cheek)	6x9	Level III	7x12	None	Primary	09
4	34	M	SCC(Cheek)	6x6	Level III	7x8	Partial flap necrosis	Skin graft	15
5	68	M	SCC(lower Lip)	7x9	Level III	10x8	None	Primary	12
6	32	M	SCC(lower Lip)	5x4	Level III	7x5	None	Primary	13
7	23	M	SCC(Cheek)	5x5	Level III	7x5	None	Primary	12
8	59	M	SCC(Cheek)	7x4	Level III	9x6	Partial flap necrosis	Primary	15
9	35	M	SCC(lower Lip)	4x4	Level III	6x5	None	Primary	08
10	37	M	SCC(Cheek)	6x4	Level III	8x6	None	Primary	12
11	42	M	SCC(Upper Lip)	5x4	Level III	7x5	None	Primary	13
12	39	M	SCC(Cheek)	4x5	Level III	6x8	None	Primary	19
13	47	M	SCC(Cheek)	6x6	Level III	7x10	None	Skin graft	11
14	41	M	SCC(Cheek)	5x7	Level III	8x7	None	Primary	12
15	68	M	SCC(Cheek)	5x4	Level III	5x7	None	Primary	13
16	32	M	burn injury	4x7	Not done	5x9	None	Primary	12
17	44	M	SCC(Cheek)	4x3	Level III	5x5	None	Primary	10
18	23	M	SCC(Cheek)	5x8	Level III	8x9	None	Skin graft	15
19	17	M	Fire arm injury	9x6	Not done	9x8	None	Primary	11
20	58	M	SCC(lower Lip)	9x5	Level III	9x10	None	Skin graft	12
21	45	M	SCC(submandibular gland)	8x7	Level III	9x7	None	Primary	13
22	33	M	SCC(lower Lip)	8x5	Level III	9x8	None	Primary	09
23	43	M	SCC(Cheek)	5x4	Level III	6x5	None	Primary	11
24	24	M	SCC(Cheek)	4x7	Level III	5x9	None	Primary	12
25	41	M	SCC(Cheek)	5x4	Level III	5x7	None	Primary	13
26	66	M	SCC(Cheek)	5x5	Level III	5x9	Complete flap necrosis	Primary	11
27	28	M	SCC(Upper Lip)	6x4	Level III	6x7	None	Primary	09
28	39	M	SCC(Cheek)	5x6	Level III	8x8	None	Primary	12

Table-I (B). Case wise report of defect and flap size with different demographic and surgical issues.

Case No	Age of the patient (years)	Sex	Diagnosis	Defect size (cm)	Level of neck dissection	Flap size (cm)	Complication	Donor side closure	Follow-up period
29	68	M	SCC(lower lip)	7x9	Level III	10x8	None	Primary	12
30	34	M	SCC(Cheek)	6x6	Level III	7x8	Partial flap necrosis	Skin graft	15
31	35	M	SCC(lower lip)	4x4	Level III	6x5	None	Primary	08
32	34	M	burn injury	5x6	Not done	6x8	None	Primary	12
33	59	M	SCC(Cheek)	7x4	Level III	9x6	Partial flap necrosis	Primary	15
34	47	M	SCC(Cheek)	6x6	Level III	7x10	None	Skin graft	11
35	43	M	SCC(Cheek)	4x3	Level III	5x5	None	Primary	10
36	23	M	SCC(Cheek)	5x8	Level III	8x9	None	Skin graft	15
37	24	M	SCC(Cheek)	4x7	Level III	5x9	None	Primary	12
38	28	M	SCC(Upper lip)	6x4	Level III	6x7	None	Primary	09
39	41	M	SCC(Cheek)	5x7	Level III	8x7	None	Primary	12
40	37	M	SCC(Cheek)	6x4	Level III	8x6	None	Primary	12
41	18	M	Fire arm injury	9x7	Not done	9x9	None	Primary	11
42	65	M	SCC(Cheek)	5x6	Level III	5x10	Complete flap necrosis	Primary	11
43	37	M	SCC(Cheek)	6x9	Level III	7x12	None	Primary	09
44	42	M	SCC(Upper lip)	5x4	Level III	7x5	None	Primary	13
45	44	M	SCC(submandibular gland)	8x8	Level III	9x8	None	Primary	13
46	43	F	SCC(Cheek)	6x5	Level III	7x8	None	Skin graft	07
47	68	M	SCC(Cheek)	5x4	Level III	5x7	None	Primary	13
48	43	M	SCC(Cheek)	5x4	Level III	6x5	None	Primary	11
49	41	M	SCC(Cheek)	5x4	Level III	5x7	None	Primary	13
50	39	M	SCC(Cheek)	8x9	Level III	9x11	None	Primary	11
51	33	M	SCC(Lower lip)	8x5	Level III	9x8	None	Primary	09
52	39	M	SCC(Cheek)	4x5	Level III	6x8	None	Primary	19
53	58	M	SCC(Lower lip)	9x5	Level III	9x10	None	Skin graft	12
54	39	M	SCC(Cheek)	5x6	Level III	8x8	None	Primary	12
55	23	M	SCC(Cheek)	5x5	Level III	7x5	None	Primary	17
56	32	M	SCC(Lower lip)	5x4	Level III	7x5	None	Primary	13

Case No	Age of the patient (years)	Sex	Diagnosis	Defect size (cm)	Level of neck dissection	Flap size (cm)	Complication	Donor side closure	Follow-up period
57	65	M	SCC(Cheek)	5x6	Level III	5x10	Complete flap necrosis	Primary	11
58	23	M	SCC(Cheek)	5x8	Level III	8x9	None	Skin graft	15
59	39	M	SCC(Cheek)	8x9	Level III	9x11	None	Primary	11
60	43	M	SCC(Cheek)	5x4	Level III	6x5	None	Primary	11
61	35	M	SCC(lower lip)	4x4	Level III	6x5	None	Primary	08
62	32	M	SCC(lower lip)	5x4	Level III	7x5	None	Primary	13
63	37	M	SCC(Cheek)	6x9	Level III	7x12	None	Primary	09
64	39	M	SCC(Cheek)	5x6	Level III	8x8	None	Primary	12
65	43	M	SCC(Submandibular gland)	7x8	Level III	9x9	None	Primary	13
66	58	M	SCC(lower lip)	9x5	Level III	9x10	None	Skin graft	12
67	39	M	SCC(Cheek)	4x5	Level III	6x8	None	Primary	19
68	41	M	SCC(Cheek)	5x4	Level III	5x7	None	Primary	13
69	33	M	burn injury	5x7	Not done	6x9	None	Primary	12
70	45	F	SCC(Cheek)	7x5	Level III	8x8	None	Skin graft	07
71	34	M	SCC(Cheek)	6x6	Level III	7x8	Partial flap necrosis	Skin graft	15
72	41	M	SCC(Cheek)	5x7	Level III	8x7	None	Primary	12
73	16	M	fire arm injury	9x6	Not done	9x6	None	Primary	11
74	37	M	SCC(Cheek)	6x4	Level III	8x6	None	Primary	12
75	28	M	SCC(Upper lip)	6x4	Level III	6x7	None	Primary	09
76	24	M	SCC(Cheek)	4x7	Level III	5x9	None	Primary	12
77	23	M	SCC(Cheek)	5x5	Level III	7x5	None	Primary	17
78	68	M	SCC(Cheek)	5x4	Level III	5x7	None	Primary	13
79	47	M	SCC(Cheek)	6x6	Level III	7x10	None	Skin graft	11
80	68	M	SCC(lower lip)	7x9	Level III	10x8	None	Primary	12
81	59	M	SCC(Cheek)	7x4	Level III	9x6	Partial flap necrosis	Primary	15
82	42	M	SCC(Upper lip)	5x4	Level III	7x5	None	Primary	09
83	45	M	SCC(Cheek)	4x3	Level III	5x4	None	Primary	10
84	33	M	SCC(Lower lip)	8x5	Level III	9x8	None	Primary	09

island flap as lighter in weight as it does not contain a muscular pedicle, as deltopectoral flap or pectoralis major myocutaneous flap, so it can be of advantage in reconstruction of lining defects.¹⁹ Dissection of the flap is kept in the sub-fascial plane as the vascular pedicle is present superficially.

Sternocleidomastoid muscle, the external jugular vein and the clavicle are used as landmarks that form a triangle in which the vessel of this flap emerges. Omohyoid muscle is another important landmark as it is nearer to the vascular pedicle; the surgeon must stay cautious while performing the dissection if omohyoid muscle is visible. Secondary drainage of the flap is through external jugular vein; it still can be ligated and divided to provide a superior arc of rotation.²⁰

Neck dissections at Level V may damage the vascular pedicle, as they are rarely carried out nowadays; the surgeon must not be concerned by this. Even if neck dissection at Level V is required, the surgeon should perform it cautiously to preserve the vascular pedicle. Modified radical neck dissection does not contraindicate the usage of the Supraclavicular Artery Island Flap.¹⁸ Di Benedetto recommends preserving some fascia around the supraclavicular vessels to protect them and avoid failure of the flap.¹³

Vinh et al. suggested the usage of a local flap or a split thickness skin graft for closure of donor sites wider than ten centimeters²¹; while others prefer primary closure whenever it is possible.^{10,13,22} A sixteen centimeters wide donor site was closed primarily by Pallua.¹⁰ As closure under tension is related with a higher possibility of unaesthetic scar and complications, wound dehiscence may occur.

Since patients with tumors in later stages typically present with diminished clinical condition and decreasing hospitalization time and surgical morbidity must be given a priority in their treatment. The supraclavicular artery island flap offers some good quality soft tissue that is quite suitable for complex facial soft tissue reconstruction. This flap also proved to be ideal where soft tissue loss in

lower third of face was noted due to firearm injury and burn injury, and provided with satisfactory soft tissue reconstruction with good aesthetic results.

CONCLUSION

Supraclavicular Artery Island Flap is an excellent alternate to other local and regional flaps with impressive recovery, acceptable skin color match and restoration of anatomic function at recipient site without any complications. Primary closure is done for the donor site, and generally heals without any complications. However, the Supraclavicular Artery Island flap has its limits in length due to its rotational nature and due to availability of limited soft tissue; it is not capable of reconstructing larger head and neck defects.

ACKNOWLEDGEMENTS

The authors would like to thank The Department of Plastic & Reconstructive Surgery at Dow University of Health Sciences & Dr. Ruth KM Pfau, Civil Hospital, Karachi, Department of Oral & Maxillofacial Surgery at Ziauddin Medical University, Karachi & The Department of Oral and Maxillofacial Surgery at Karachi Medical & Dental College, Abbasi Shaheed Hospital, Karachi for their general support.

CONFLICT OF INTEREST

All authors disclose any financial and personal relationships with other people or organization that could inappropriately influence their work. All surgeries were performed at Dr. Ruth KM Pfau Civil Hospital, Karachi where treatment is provided free of cost.

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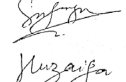
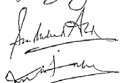


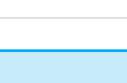
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Being realistic is the most commonly traveled road to mediocrity.

– Unknown –

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AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Hyder Ali	Chief Plastic Surgeon involved in performing all surgeries, posoperative follow-up of patients, final approval of the manuscript and responsible for accuracy and integrity of results.	
2	Noor ul Wahab	Chief Oral and maxillofacial Surgeon involve in performing the Surgeries and critical review of the manuscript.	
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4	Huzaifa Saeed ul Khair	Oritinal design and writing of manuscript and assisting chief surgeons while performing surgeries.	
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6	Syed Muhammad Ali	Critical review of manuscript, Postoperative care & follow-up of patient.	
7	Masood Hussain Rao	Rewriting the whole manuscript, developing new formatting of tables and results.	
8	M. Ashraf Ganatra	Supervising all the surgeries and assessment of all patients before discharge.	