RECONSTRUCTION OF THE AXILLA BY PERFORATOR-BASED PROPELLER FLAP

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Abstract

Abstract: - Axillary reconstruction is very important. As the shoulder joint has a very wide range of motion, any axillary contractures restrict its various movements. The choice of reconstruction should have a special criterion to achieve full range of motion, due to wide range of shoulder abduction.
Objective: -To evaluate perforator-based propeller flap in reconstruction of the axilla regarding functional and aesthetic consideration.
Patients and methods: Twenty patients with axillary defects were reconstructed by perforator- based propeller flap in the plastic surgery department, Beni-Suef University, in the period between February 2018 till August 2021. The study included 14 males and 6 females with the age range between 14 - 50 ys. Eighteen patients with unilateral reconstructed axillae and two patients with bilateral reconstructed axillae. Twelve patients had hidradenitis suppurativa, 5 patients had grade III burn scar contracture, and 3 patients had a post-traumatic defect. 13 patients were reconstructed immediately, and 7 patients were delayed for 2 weeks; these patients were suffering from hidradenitis suppurativa after excision of the lesion, waiting until edema and inflammation completely subsided.
Results: -12 (54%) patients healed eventually without major complications, 8 patients had flap complications, one patient had complete flap loss (4.5%), 5 had partial or distal flap loss (22.7%), two had venous congestion (9.1%). Other complications related to donor site were reported, like dehiscence 4 (18.2%), hematoma 2 (9.1%), and wide scar 2 (9.1%). Patients were evaluated according to functional, aesthetic outcomes, and patient satisfaction. Overall results were satisfactory.
Conclusion: - Reconstruction of axillary defect due to any cause by perforator-based propeller flap has superior functional and aesthetic results.

Keywords: Reconstruction; Axilla; Perforator; Propeller; Flap

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1. INTRODUCTION

Various traumatic axillary scar contractures usually result from a burn, the most common in developing countries, excision of hidradenitis suppurativa, and after axillary lymph node dissection (1).
Rehabilitation of contracted axilla is hard for reconstructive surgeons. This difficulty arises from severe joint stiffness, splinting difficulty, and multiple recurrence rates with insufficient care. The anterior and posterior folds of the axilla stretched during full shoulder joint abduction, which requires good cutaneous gliding capacity at the shoulder joint area. The lateral aspect trunk skin also moves upwards. Management of these contractures at the axilla must regain these possibilities of gliding (2).
The surgical procedure chosen for axillary defect reconstruction can be made according to surrounding skin conditions and the defect size. The flaps have a superior choice over the skin graft due to their superior functional and aesthetic results (3).
Many flaps have been described for axillary reconstruction, including local, regional, and free flaps, either in the form of a musculocutaneous flap, Limberg flap, or fasciocutaneous V-Y flap. The defects resulting from excision of grade 3 axillary hidradenitis suppurativa reported superior results when reconstructed by perforator flaps, such as the thoracodorsal artery perforator (TDAP) flap (4).
The design of the propeller flap looks like a fan with an unequal length of its 2 blades, its pivot point formed by the perforator, the long arm when the blades are switched comfortably fills in the defect. It is a local island fasciocutaneous flap based on a single dissected perforator (5).
The first propeller flap reported by Hyakusoku et al. in 1991 for axillary reconstruction was with a subcutaneous pedicle. He stated that the perforating vessels are usually constant in their anatomy (6).

2. PATIENTS AND METHODS

A case series study was performed on all consecutive patients suffering from axillary defects at the plastic and reconstructive surgery department at Beni-Suef University Hospital. All patients who underwent reconstruction of the axilla between February 2018 and August 2021 were identified from the hospital database. Three distinct rows of perforator groups were well detected in the lateral thoracic region, at intervals parallel to the anterior border of the latissimus dorsi muscle. The first row is a longitudinal series of direct cutaneous perforators arising from the lateral thoracic vessels and is located on the serratus anterior muscle along the lateral border of the pectoralis major muscles. The second row, about 2 cm anterior to the latissimus dorsi muscle border, comprises septocutaneous (or direct cutaneous) perforators from the cutaneous branches of thoracodorsal vascular systems. The third row is composed of musculocutaneous perforators through the latissimus dorsi muscle, and its anterior group is located within 2 cm of the anterior border of the latissimus dorsi muscle. This flap differs totally from the parascapular flap. The island fasciocutaneous flap can be raised on any perforator at the lateral thoracic region from the 3 rows mentioned above, so it has no constant anatomy. However, the parascapular flap is pedicled, has constant anatomy based on the circumflex scapular artery. Our flap can be raised on any perforator from these rows close to the defect (7).

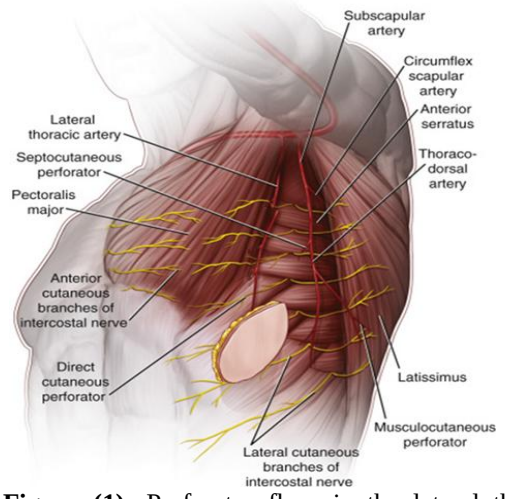

Figure (1): Perforator flaps in the lateral thoracic region (7).

Inclusion criteria

Patients with major axillary defects after wide local excision (1cm below the hairline) either due to chronic inflammation (hidradenitis suppurativa), trauma, or excision of burn scar causing contracture were included in this study.

Exclusion criteria

All patients with a small axillary defect or mild degree of contracture that can be treated by direct closure or local flap were excluded from this study. Also, patients suffering from peripheral vascular ischemia, Heavy smokers > 20 cigarettes/day, patients with multiple comorbidities (like liver, renal, and heart), and non-co-operative patients were excluded from this study. All patients have consented in both verbal and written ways, also consented to take photos.

Patient evaluation

After taking a full history, a general examination, and a local examination with special emphasis on the size and depth of the defect, the absence of a perifocal lesion after excision, and the degree of stiffness from pain, particularly after a long period of contracture, were performed. Preoperative investigations, laboratory investigations (CBC, LFT, RFT, Coag. profile), imaging including either handheld Doppler that was used for identification and marking of perforators near the expected defect or Color Duplex that was done for 3 patients in whom results of handheld Doppler were not conclusive, were conducted.

Preoperative planning

A handheld Doppler probe (5-8 MHz) or color duplex ultrasonography was usually enough for preoperative vascular assessment. A flap was selected around the perforator that has the strong pulse and nearest location. Flap size was designed according to the defect size (Fig.1).

Operative details

All patients received general anesthesia, positioned laterally in either right or left lateral position, operated with the arm fully abducted 180 c between the upper limb and trunk. Intravenous antibiotic (amoxicillin + clavulanic acid 1gm) was received immediately preoperatively. The design and size of the flap were adjusted according to the size of the defect and the position of the discovered perforator (Fig. 1). After incising the flap edges, subfascial dissection of the flap using loupe magnification (2.5 X) was used to identify the best perforators around the defect (Fig. 2). The best one was chosen based on pulsatility, caliber, orientation, number, and caliber of accompanying veins and course.

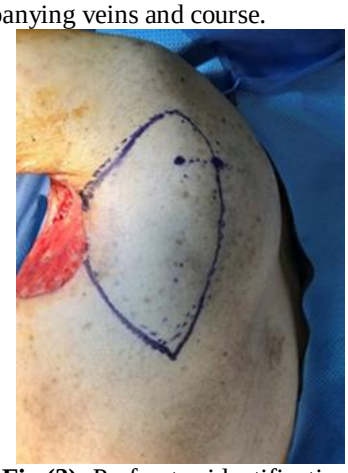

Fig (2): Perforator identification,

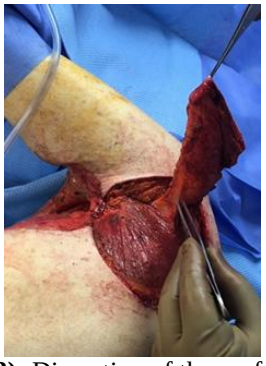

Fig (3): Dissection of the perforator

Flap design

Fig (4): Rotating the flap and

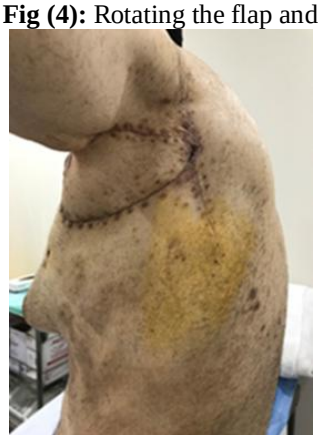

Fig (5): Late post op.

donor site closure

Flap insetting

The flap was rotated clockwise and counterclockwise, trying the best for vessel rotations to avoid any kinking of the vessels. After the new position of flap rotation, the pedicle was checked to avoid twisting and further dissection if any limitation existed. The flap was then settled in its position and observed for any vascular compromise regarding bleeding, capillary refilling, and color (Fig. 3).

Donor site closure

After proper dissection of the edges, big suction drains were inserted to prevent any collections at the donor site and direct closure of the donor site. Small rubber drains were also inserted under the flap far away from the perforator site to avoid spasm of the perforator.

Postoperative care: The patient was placed in a warm room with good hydration, including IV fluids and good oral intake. The arm was abducted 70 degrees. Early postoperative monitoring of the flap was performed. IV antibiotics were continued for at least 5 days postoperatively. Anti- thromboembolic prophylaxis (enoxaparin 40 mg.SC once/day) was given during the period of recumbency. Any sources of flap compression were avoided. Drains at the donor site were to be removed usually on the 5th day. Sutures were removed on the 15th day, then anti-scar creams were applied for 3 months. Normal daily activities were started after 3 weeks. Physiotherapy was started after 3 weeks.

Analyzed parameters:

All patients' data were recorded (see Table 1). Patients were evaluated according to functional outcome measured by Constant-Murley score; a 100-point scale used to determine the shoulder's functionality after treatment. The test is divided into the following 4 subscales: pain (15 points), activities of daily living (20 points), strength (25 points), and range of motion (forward elevation, external and internal rotation, and abduction of shoulder) (40 points). The higher the score, the higher the quality of functions. Evaluation of aesthetic outcome depends on assessing certain parameters such as color match, texture match, the contour of the axilla, and scar complications. Each item takes a score of 0 to 3. A score of 10 to 12 is considered excellent, a score of 7 to 9 is considered good, a score of 4 to 6 is considered fair, and a score of less than four is considered poor and patient satisfaction were reported after follow up.

Table 1: Collective demographic data of all patients included in this study.

No.	age	sex	Risk factors	etiology	Timing	Flap size	Operative time	complication	management	Functional outcome	Aesthetic outcome	Patient satisfaction
1	42	M	DM	HS	early	15*10	200m			good	excellent	Very satisfied
2	31	M	Smoker	HS	early	18*14	150m	Venous congestion	Heparin	good	excellent	Very satisfied
3	35	M	Smoker	Trauma	late	16*15	120	Donor dehiscence	2ry sutures	accepted	good	satisfied
4	47	F		HS	early	13*18	160	Partial loss	Debridment+2ry intention	good	poor	unsatisfied
5	40	M	Smoker	HS	early	12*15	150	Venous congestion	Heparin	good	excellent	Very satisfied
6	37	M		HS	early	14*18	130			good	good	satisfied
7	42	M	Smoker	Burn	late	14*16	90	Hematoma at donor	Aspiration	good	fair	satisfied
8	38	F		HS	early	18*10	100	Total loss	Debridment+2ry intention	Unaccepted	poor	unsatisfied
9	45	M	DM	Trauma	late	17*12	110	Distal necrosis	observation	accepted	good	Low satisfied
10	41	M		HS	early	15*15	100			Good	excellent	Very satisfied
11	28	F	DM	Burn	late	12*12	80	Donor scar	Topical creams	Good	good	satisfied
12	26	M	Smoker	HS	early	12*8	90	Distal necrosis		Good	excellent	Very satisfied
13	54	F		Burn	late	15*12	100	Donor scar		Good	excellent	Very satisfied
14	20	F	DM	HS	early	16*10	90	Donor dehiscence	2ry sutures	Good	excellent	Very satisfied
15	27	M		HS	early	8*10	120			accepted	excellent	Very satisfied
16	49	F		Trauma	early	12*18	120	Donor dehiscence	2ry intention	Good	fair	Low satisfied
17	45	M	DM	Burn	late	15*17	80			Accepted	excellent	Very satisfied
18	51	M	Smoker	HS	early	12*11	90	Distal necrosis		Good	excellent	Very satisfied
19	25	F		HS	early	15*1O	100	Donor hematoma	Aspiration	good	excellent	Very satisfied
20	50	M	DM	Burn	late	14*15	100	Donor dehiscence	dressing	accepted	excellent	Very satisfied

Ethical Consideration: - Approval by the institutional ethical committee was taken. Time was spent with the patient and his family, explaining the procedure in detail utilizing photographs and video imaging. All inquiries from the parent regarding possible complications, Duration of hospital stay, time to return to regular activity, and any other inquiry were discussed in detail with patient.

Individual Consent Process: -

Informed consent was taken after informing the study objectives and the procedures to potential participants. Participants was voluntary, and we told the participants that the decision hey took would not affect the quality of care they would receive.

3. RESULTS

Total 20 patients with axillary defects were included in this study, 12 after excision of hidradenitis suppurativa, 5 after excision of burn scar, 3 after trauma. 2 patients had bilateral axillary defect after excision of HS, so a total of 22 propeller flaps was performed. Fifteen axillae were reconstructed at excision, and seven axillae were reconstructed two weeks after excision. The age of the patients ranged between 14-50 ys with a mean age of 38 ys, 14 males and 6 females. The average defect dimensions ranged between 8 – 18 cm in length and 10 -18 cm in width. Twelve patients (54%) healed eventually without major complications, 8 patients had flap complications, one patient had complete flap loss (4.5%) managed conservatively by repeated dressing helped by VAC , 5 had partial or distal flap loss (22.7%) treated by debridement and secondary sutures, two had venous congestion (9.1%)managed by heparin soaks and observation. Other complications related to donor site were reported, like dehiscence 4 (18.2%), hematoma 2 (9.1%), and wide scar 2 (9.1%).

Fig (5) post traumatic raw area

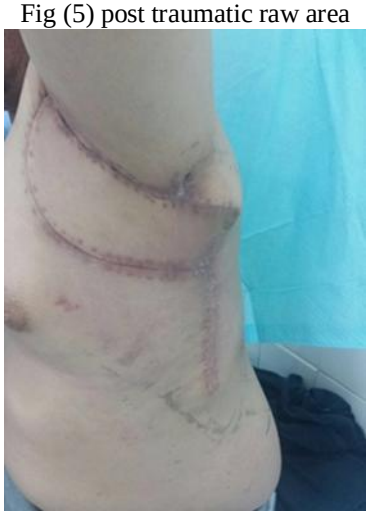

Fig (6) reconstructed by propeller flap late post op

Fig.5,6: - 32ys old male with post traumatic raw area reconstructed by propeller flap after 2 wks of trauma, flap size was 12*17cm

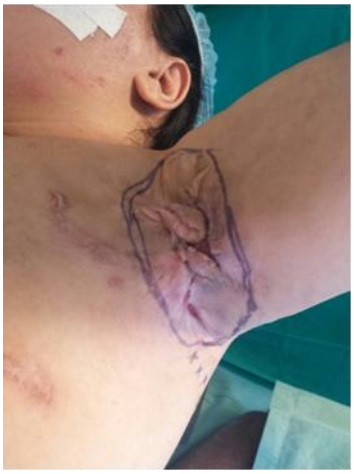

Fig (7) Grade III HS

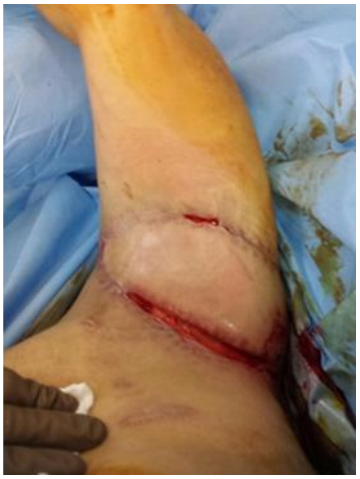

Fig (8) Reconstructed by propeller flap complicated by Wound dehiscence

Fig 7,8: -grade 3 hidradenitis suppurativa excised and reconstructed by propeller flap, size of the flap was 15*11cm, complicated by wound dehiscence.

4. DISCUSSION

Reconstruction of the axilla is challenging as axillary scar contractures restrict various movements because the shoulder is the most mobile joint in the human body (8).

The use of a propeller flap to resurface burn scar contractures at the axilla was introduced in 1991 by Hyakusoku et al. to describe a skin island of a length largely exceeding its width, made of two portions (the blades of the propeller), one at either side of the pedicle, based on a random subcutaneous pedicle, with the flap is rotated 90° on the central pedicle (9).

Considering the etiology of the defect noted in Ndiaye et al.'s study, all cases of axillary reconstruction were due to post-burn sequelae, in contrast to our study where hider adenitis suppurativa, burn scar contracture, and axillary defect after trauma were included (10).

Elgohary et al. studied 28 operations for 20 patients undergoing wide local excision with TDAP flap coverage of the defect. The size of the defect ranged from 8 × 12 to 12 ×17 cm, but in our study, the defect size ranged from 8×10 to 18×13 cm.

According to our study, the mean operative time was 111 minutes, starting at 200 minutes and decreasing to 80 minutes due to improvement in our learning curve. However, in Elgohry et al.'s study, the mean ± SD operative time was 210 ± 25 minutes due to rechanging position and re- sterilization between different operation steps (11).

Considering donor site closure, all donor sites in our study closed primarily, even with the largest defect, which was18*13 cm. These results agreed with the study done by Mahfouz (12), disagreed with Roswell et al., that used pedicled pectoralis major flaps and other myocutaneous flaps in reconstructing the axilla that left large donor site defects that required skin grafting that resulted in a bad aesthetic appearance (12).

Balázs and his colleagues, in their study of axillary reconstruction by TDAPF, included 15 patients who reported a flap complication rate of 23.3% and venous congestion occurred in 25% with total flap loss in one patient (6.9%) (13). However, in our study, eight patients had flap complications, one patient had complete flap loss (4.5%), five had partial or distal flap loss (22.7%), two had venous congestion (9.1%).

Other complications related to the donor site were reported, like dehiscence 4 (18.2%), hematoma 2 (9.1%), and wide scar 2 (9.1%). That was managed by simple maneuvers like Yinglun et al., who had dehiscence of 13 (25%), surgical site infection 1 (2%), and decreased shoulder range of motion 2 (4%) that were managed simply by repeated dressing (14).

After functional outcome evaluation, it was shown that 14 (70%) patients showed good functional outcomes (score >80), accepted in 5 (25%) patients (score >60), unaccepted in one (5%) patient as measured by the Constant-Murley score.

Elgohary et al. used the same score in their study for functional evaluation. They noticed a marked improvement in the quality of shoulder function after treatment reaching near-normal, especially regarding pain, daily activity, and range of movement (11).

By talking about the aesthetic outcome results of our study showed that 12(60%) patients had excellent results (score=10), 4 (20%) patients had good results (score=8), 2(10%) patients had fair results (score=5), and two patients had poor results (score=3) as measured by digital supplemental content 1 and 2. However, in Elgohary et al.'s study, the aesthetic outcome is accepted in 85% of flaps, with 18 patients (90%) satisfied with the aesthetic appearance. The main cause of poor satisfaction was the disparity between the two sides in the patients with bilateral disease (11).

60% of our operated patients were very satisfied. 20 % reported being satisfied, and their main concern was the donor site scar (20%). 10% had low satisfaction due to donor site scar and having bulky flap on axilla. 10% were unsatisfied who suffered total and partial flap loss and required late coverage either by a skin graft or left to heal by secondary intention.

In Mahfouz's study, the degree of patient satisfaction was all satisfied by the results except two dissatisfied by back scar and difficulty in full adduction due to bulkiness of the flap in the axilla (15).

We think that reconstruction of the axilla by perforator-based propeller showed good functional, aesthetic outcomes, and patient satisfaction..

5. SUMMARY AND CONCLUSION

Reconstruction of axilla by perforator-based propeller flaps had become challenging. The axilla is surrounded by multiple perforators that can undergo a wide rotation and mobilization due to its reliable vascular pedicle and without sacrificing major trunk vessels. Flap harvesting is rapid, and there is no need for microsurgery to prevent complications. It is essential to select patients accurately, planning preoperatively with good meticulous dissection. Propeller flaps proved to be effective regarding the viability of the flap, a suitable cover of various defects, and decreasing the donor site defect with overall satisfactory aesthetic, functional outcomes, and patient satisfaction.

Disclosure: - The authors declared that there is no conflict of interest

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