Egypt, J. Plast. Reconstr. Surg., Vol. 38, No. 1, January: 11-16, 2014

The Use of Proximally Based Pedicled Lateral Forearm Flap for Coverage of Elbow and Cubital Fossa Defects

SHERIF EL-KASHTY, M.D.* and IBRAHIM KAMEL, M.D.**

The Department of Plastic & Reconstructive Surgery, Faculties of Medicine, Menoufia and Ain Shams** Universities*

ABSTRACT

Background: Local fasciocutaneous flaps form an important part in the reconstructive ladder for soft tissue coverage of elbow defects, often following release of post-burn contractures and post-traumatic defects. There are numerous fasciocutaneous flaps around the elbow, given the rich collateral circulation of both the medial and lateral arm, which extends onto the forearm.

Material and Methods: In this study, we used the proximally based pedicled lateral forearm flap to cover the volar surface of the elbow in 11 patients (5 females and 6 males). Of these 11 patients, eight patients had post-burn contracture of the elbow and the other 3 patients suffered from volar soft tissue defects of elbow joint following trauma. The flap is proved to be thin, pliable, easy to rise, and well-fitted in line with the axis of elbow flexion-extension movements. The flap covered the defect either totally in small to moderate defects, while in big defects, the flap resurfaced the strategically important axis of joint motion, with the aid of a skin graft applied over non-mobile surface.

Results: The flap donor site is closed primarily in most of cases. The follow-up period ranged from 6 to 12 months. All patients were satisfied with the supple volar surface of the elbow and no recurrence of contracture occurred. This flap can be considered a valuable option for covering of elbow defects.

INTRODUCTION

Soft tissue defects of the elbow can result from either release of post-burn contractures, trauma, tumor excision, or olecranon pressure sores. The coverage options, following the reconstructive ladder, will start from direct closure, skin grafting, local skin flaps, combination of a skin flap and graft, a muscle or muscle-skin flap, pedicled skin flaps from the trunk, and ending by free flaps **[1]**.

The use of skin grafting for coverage of elbow defects, either as partial thickness or full thickness, is the most fundamental technique of wound coverage that is technically simple with minimum morbidities, but unfortunately plagued by high incidence of contracture recurrence, prolonged post-operative splintage and physiotherapy, and the aesthetic concerns especially in females **[2]**. Free tissue transfer is another good solution **[3]**, yet it is not available in all plastic surgery centers and technically demanding **[4]**.

Anterior chest wall skin flaps to the forearm and hand defects may be used as part of the initial treatment of an acute loss of skin, or as the first stage in later reconstruction of a disabled upper extremity **[5]**. At the current time in the era of the axial pattern flaps and free flaps, these random pattern flaps elevated from the anterior chest wall, and requiring two stage procedure, remain infrequently needed **[6,7]**.

Local fasciocutaneous flaps around the elbow form an important part of soft tissue coverage for elbow defects, often following burns, trauma, tumor excision, and olecranon pressure sores. The options available among these fasciocutaneous flaps are numerous, given the rich collateral circulation of both the medial and lateral arm, which extends onto the forearm. The ideal flap, which may be derived from any of these territories, would be thin, pliable, and its donor site either entirely or partially closed primarily **[8]**.

The basis for the proximally based pedicled lateral forearm flap originated from the careful anatomical studies of the forearm fascial extension of the vascular pedicle, of the well known lateral arm flap, which is the posterior radial collateral artery (PRCA). This PRCA pedicle is found to divide into anterior and posterior divisions 4cm proximal to the lateral epicondyle. The posterior division anastomoses with the interosseus recurrent artery and supplies the circulation around the elbow,

including the joint and skin. The anterior division is of more interest, since it extends along the lateral forearm extensor surface in the axis of the brachioradialis muscle, for an average of 15cm 13 to 18cm (Fig. 1) **[9,10]**. This article will describe the use of the proximally based pedicled lateral forearm flap for coverage of volar elbow defects in 11 patients.

PATIENTS AND METHODS

This study was conducted in the Departments of Plastic Surgery of Menoufia and Ain Shams University Hospitals from April 2011 to June 2012 with follow-up period of an average 12 months. The study was carried on 11 patients (6 females and 5 males). Of those 11 patients, 8 patients had post-burn contractures of the elbow of varying degrees of severity, and the other 3 patients had post-traumatic skin loss of the volar surface of the elbow of varying sizes. The age of the patients ranged from 2 to 23 years.

As regards the 8 patients with post-burn contracture of the elbow, there were inclusion criteria as passage of at least one year post burn for the scar to be fully mature, the non-surgical treatment (physiotherapy) became ineffective, and more crucially, the availability of healthy uninjured skin over the axis of the brachioradialis muscle (flap territory).

Preoperatively, all patents with post-burn contractures were evaluated for the following features:

1- The extent of joint contracture was determined and the passive and active range of motion was assessed. Radiographic evaluation was obtained to delineate structural integrity of the joint.

2- The magnitude of the scaring and scar thickness were assessed. The scar usually was thickest across the joint surface.

3- The location and the size of the uninjured skin of the flap territory over the axis of the brachioradialis muscle were assessed.

4- The axis of the joint rotation was located. The line of the incisional release of the contracting scar will be in alignment with the axis of joint movement.

Preoperative markings:

With the elbow joint semi-flexed and the forearm midway between pronation and supination, the lateral epicondyle was marked as the pivot point of the flap, the flap was marked as a tongue-shape, proximally based design over the axis of the brachioradialis muscle for up to 15cm long, (Fig. 1).

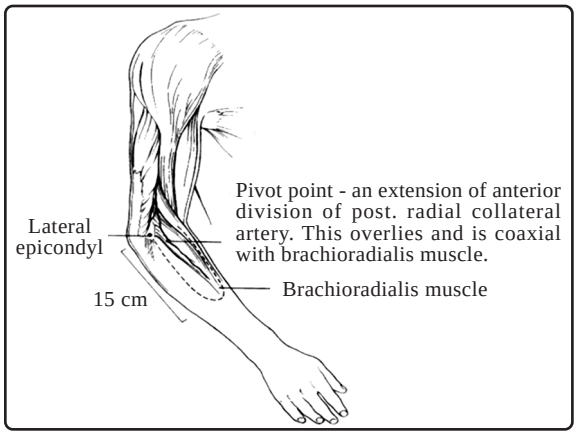


Fig. (1): Layout and plan for proximally based lateral forearm flap based on extension of posterior radial collateral artery on axis on of brachioradialis muscle.

Surgical technique:

Under general anesthesia, release of joint contracture by incising the scar tissue was done by making an incision in the scar across the joint surface. The incision was placed in the line with the axis of joint rotation. The incision was confined within the width of the scar initially, and was lengthened as necessary to achieve the intended release. The incision was done with caution to avoid injury of major vessels and nerves. The extent of release was assessed by the improvement of joint motion gained as the scar tissue was severed.

Elevation of the proximally based lateral forearm flap was then begun by incising the flap margins including the deep fascia. The flap was elevated as a fasciocutaneous one from distal to proximal up to the pivot point (lateral epicondyle). The size of the flap was fashioned according to the size of the defect, and the flap was rotated 90 degree to cover the defect, either totally in cases of small defects, or at least in big defects, the flap partially, covered the axis of the joint rotation with the aid of piece of skin graft above it. The donor site is closed either primarily or with skin grafts according to the flap size.

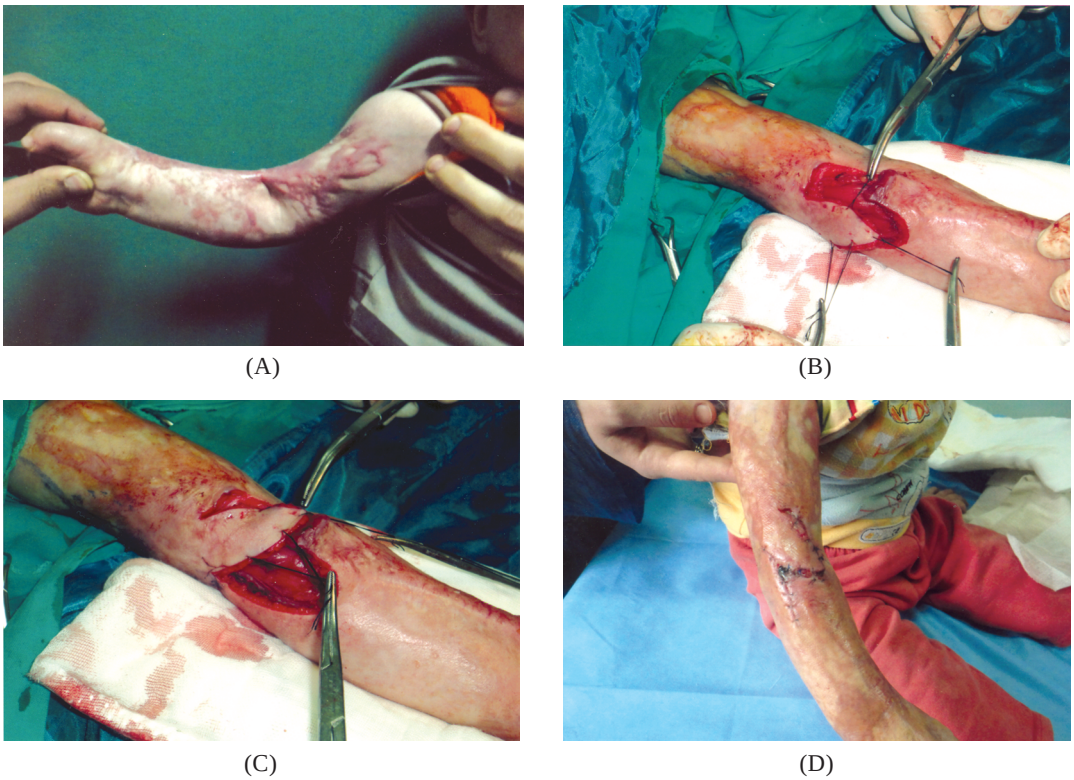
RESULTS

The whole 11 flaps survived completely without loss (Figs. 2-5). Only one flap showed very superficial necrosis at the most distal tip, measuring about 1x1cm that healed with conservative treatment. The dimensions of the flaps used ranged between 6x4cm, and 15x7cm. The operative time for flap elevation ranged between 20 and 30 minutes.

For the 3 post-traumatic cases, all the donor sites were closed primarily, and the flaps covered the traumatic defect completely in 2 cases having small defects, while in the 3rd case with big defect, the flap, partially, covered the strategically important axis of joint rotation, and a piece of STSG was applied above the flap, (Fig. 5).

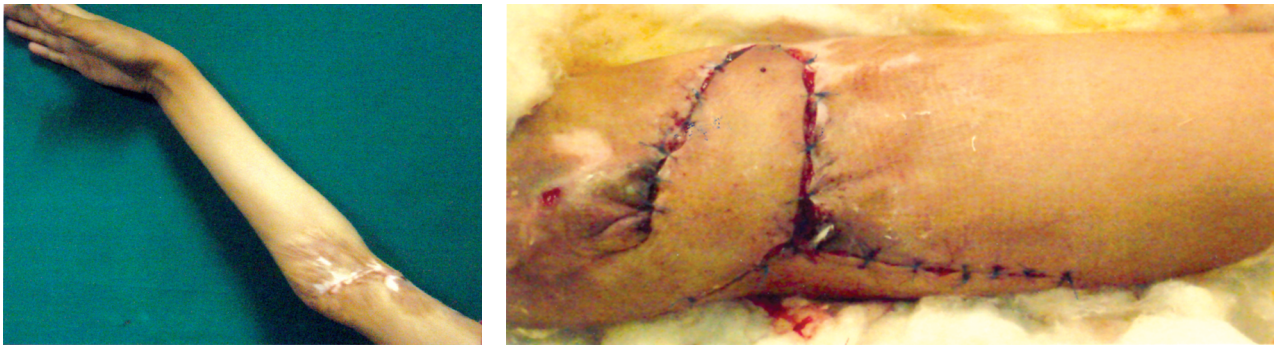
As regards the 8 post-burn cases, the flap donor sites were closed primarily and the flaps were sufficient to cover the post release defect completely in 6 patients of mild to moderate defects, (Figs. 2,3), whereas in the remaining 2 cases who had big post release defect, the flaps were transposed to cover the rotation axis of the elbow joint and the flap donor sites were skin grafted, (Fig. 4). Complete take of skin grafts occurred in 2 patients with marginal loss for the 3rd case (Fig. 4) which healed conservatively. The donor sites of the skin grafts healed nicely without complications.

During the follow-up period, all the patients had stable coverage of the volar surface of the elbow with thin and supple flap that allowed free flexion and extension with no recurrence of the elbow contracture. The flap donor sites and the skin grafted areas were aesthetically accepted and the patients were totally satisfied.



(A) (B) (C) (D)

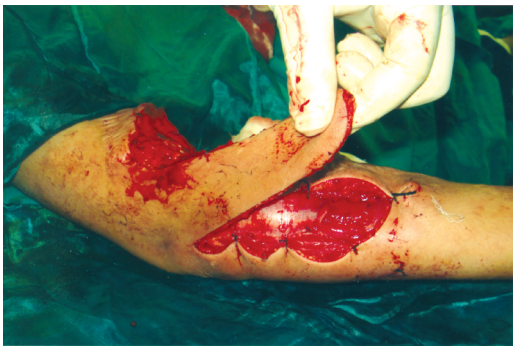
Fig. (2): (A) Post-burn contracture of 2 years old boy, (B) Contracture released and flap elevated, (C) Flap transposed into the defect, (D) Post-operative full extension of elbow.



(A) (B)

Fig. (3): (A) Post-burn contracture of 12 years old female, (B) Close up view of the immediate result.

(A)



(B)

(C)

(D)

Fig. (4): (A) Post-burn contracture of 18 years old female, with preoperativ flap marking, (B) Contracture released and flap elevated, (C) 2 weeks postoperative view showing flap and donor site skin grafted, (D) 2 months postoperative view showing full extension of elbow joint.

(A)

(B)

(C)

Fig. (5): (A) Preoperative marking of the flap, (B) Immediately postoperative, flap covered the axis of joint motion and a piece of skin graft applied above the flap, (C) Flap donor site closed primarily.

DISCUSSION

Soft tissue defects around the elbow and cubital fossa defects can be the result of either release of post-burn contractures, trauma, tumor excision, or debridement of olecranon pressure sores. Following the reconstructive ladder, the reconstructive options will start from skin grafting and end by using free tissue transfer **[1]**.

Skin grafting the defect is simple, but plagued by high incidence of recurrence of contracture and the need for re-operative surgery **[2]**. The free tissue transfer is technically demanding and has a high failure rate **[3,4]**. Pedicled flaps from the chest wall to cover elbow defects are plagued by being a two stage procedure and limb immobilization during the first stage **[5-7]**. Fasciocutaneous flaps around the elbow have the merits of being thin, pliable, and the donor sites can be closed either entirely or partially primarily **[8]**.

Lanzetta et al., **[9]** in their clinical and anatomical study found that the posterior radial collateral artery (PRCA) divided 4cm proximal to the lateral epicondyle into posterior and anterior branches, and the anterior branch is extending along the lateral forearm extensor surface in the axis of the brachioradialis muscle for an average of 15cm. This vessel is the vascular pedicle for the axial proximally based, pedicled lateral forearm fasciocutaneous flap.

Tizian et al., **[11]** used the proximally based pedicled radial forearm flap to treat soft tissue defects of the elbow in 14 patients. All their cases had stable, supple soft tissue coverage allowing full range of motion. They reported only one patient had delayed wound healing at the donor site. The disadvantage of this flap included the sacrifice of a major artery (radial artery), the potential for cold intolerance and the painful non cosmetic scar at the donor site. In our study, we had comparable results, but we avoided these disadvantages, as we did not sacrifice the radial artery, nor applied skin grafts over the flexor tendons.

Akpuaka **[12]** in his small series of cases, including post-olecranon fracture with wiring, supracondylar compound fracture, and post traumatic defects, he used the distally-based radial recurrent fasciocutaneous flap harvested from the lateral arm to treat these cases. He reported that the flap size measured from 4x4cm to 7x6cm, donor site closed either directly or with skin grafting, and the healing at the flap and donor sites as well as elbow movements were satisfactory. In our study, we got comparable results as regards the healing and free movement aspects, but we used bigger flaps up to 15x7cm.

Carriquiry **[13]** used the distally based superior medial arm flap to cover elbow defects. The flap was based on the most distal septocutaneous perforator of the brachial artery running in the medial intermascular septum. He found that it may be necessary to sever cutaneous nerves during flap mobilization, with numbness of the medial forearm being a frequent sequela. In our study, we did not sacrifice cutanoeus nerves and we did not have this sensory numbness over the lateral forearm.

The proximally based lateral forearm flap has the advantages of easiness of its technique, vascular reliability, and being thin and supple. Rotated 90 degree to reach cubital fossa, it is well suited to cover the important neurovascular bundles of the forearm, while rotated 90 degree dorsally, it could cover the posterior surface of the elbow as in cases of olecranon pressure sores or traumatic exposure. The flap as being thin and supple, it can be transposed to cover the volar elbow defect, will be of similar quality and matching, to the original volar skin, hence, it will not block flexion nor extension.

In all cases, resurfacing of joint contractures after release should be done preferably by a flap rather than a skin graft. Transferring the proximally based, lateral forearm flap from the lateral forearm to the antecubital surface, in line with the axis of elbow flexion-extension, even with the aid of skin graft either above or below the flap, satisfied this crucial requirement.

Conclusion:

In conclusion, the proximally based, pedicled, lateral forearm flap represents a good option in reconstruction of the defects around the elbow joint due to different etiologies. It is a single stage procedure with a high success rate. The flap is thin, supple, reliable and easy to harvest. It can provide a soft pliable coverage to resurface the axis of elbow joint rotation, either totally in small and moderate defects, and combined with a piece of skin graft above or below the flap in big defects.

REFERENCES

1- Ted Huang and Jui-Yung Y.: Management of contractual deformities involving the shoulder, elbow, hip, and knee joints in burned patients. In: Total Burn Care. (ed), Herndon D.N., Vol. II, Ch. 56, p. 638, 2012.

2- Huang T.T., Blackwell S.J. and Lewis S.R.: Ten years of experience in managing patients with burn contractures of axilla, elbow, wrist, and knee joints. Plast. Reconstr. Surg., 561: 70-76, 1978.

3- Harii K. and Ohmori K.: Free skin flap transfer. Clin. Plast. Surg., 3: 111, 1976.

4- Yajima H., Tamai S., Mizumoto S., Ono H. and Fukui A.: Vascular complications of vascularized composite tissue transfer: Outcome and salvage technique. Microsurgery, 14: 473, 1993.

5- Gillies H.: Design of direct pedicle flaps. Br. Med. J., 2: 1008, 1932.

6- White W.L.: Cross-chest flap grafts. Am. J. Surg., 99: 804, 1960.

7- White W.L.: Anterior chest wall skin flaps for the arm and hand. In: Grabb W, Myers B, eds. Skin flaps. Boston: Little, Brown, 397, 1975.

8- Cormack G. and Lamberty B.: The forearm angiotomes. Br. J. Plast. Surg., 35: 420, 1982.

9- Lanzetta M., St. Laurent J.Y. and Chollet A.: The lateral arm flap: An anatomic and clinical study. Presented at the Annual Meeting, American Society for Reconstructive Microsurgery, Tucson, AZ, January, 1996.

10- Heinz T.R. and vasconez L.O.: Fasciocutaneos flaps for elbow coverage. In: (Eds), Straush et al.: Grabb S, Encyclopedia of Flaps. Lippincott Williams and Wilkins, Philadelphia, USA, Vol. 3, Ch. 335, p. 967, 2009.

11- Tizian C., Sanner F. and Berger A.: The proximally pedicled radial artery forearm flap in the treatment of soft tissue defects of the dorsal elbow. Ann. Plast. Surg., 26: 40-44, 1991.

12- Akpuaka F.C.: The radial recurrent fasciocutaneous flap for coverage of posterior elbow defects. Injury, 22: 332, 1991.

13- Carriquiry C.E.: Versatile fasciocutanoeus flaps based on the medial septocutaneous vessels of the arm. Plast. Reconstr Surg., 86: 103, 1990.