ANTEROLATERAL THIGH FLAP IN LOWER LIMB RECONSTRUCTION

Le Hong Phuc[1], Tran Thiet Son[2], Le Nghi Thanh Nhan[1]

(1) Hue University of Medicine and Pharmacy, Hue University; (2) Hanoi Medical University

Abstract

Introduction: Anterolateral thigh flap is one of the most researched and widely used perforator flaps in the recent decades in plastic surgery as a whole and in limb reconstruction, especially in cases with complex deflects, in particular. This report aimed to evaluate anterolateral thigh flap in reconstruction of complex lower limb soft tissue defects. **Subjects and methods:** From August 2014 to August 2015, at Hue University of Medicine and Pharmacy Hospital, 12 cases with complex soft tissue defects in lower limb were reconstructed and covered with ALT flaps: two distal based pedicle ALT flaps for popliteal and around knee joint defects and 10 composite ALT free flaps for lower leg reconstruction. **Results:** Twelve flaps used included: two peripheral pedicled fasciocutaneous flaps, ten complex free flaps (01 complex myo-fasciocutaneous flap providing muscle for deep space filled, fascial for tendon reconstruction and surface covering of the defect; 05 vastus lareralis myocutaneous flaps providing muscle for dead space filling and covering; 04 fasciocutaneous flaps involving the fascia lata for fascial reconstruction and covering). The size of flaps ranged from 8 to 27cm in length and from 6 to 13cm in width. The largest flap was 240cm^2,the smallest was 50cm^2. All 12 flaps survived. Short-term results at one month after surgery were consideredas good in eleven patients and fair in one patient. There were no special complications at donor sites. Paresthesia at the donor site was noted in two cases. **Conclusion:** ALT flap with its versatility as peripheral pedicled flap or free flap can be used in lower limb reconstruction with high success rate of 100% (12/12). Preoperative skin perforator mapping by Doppler was highly accurate (12/12) compared with intraoperative findings. Complex free ALT flap is suitable for reconstruction of major defects involving different type of tissue in lower limb with satisfied results.

Key words: *Anterolateral thigh flap, limb, ower limb*

1. BACKGROUND

Anterolateral thigh flap (ALT) is one of the perforator flaps regularly studied and widely used today. Song et al. published a report on the first flap in 1984 using a flap based on perforator from the descending branch of the circumflex femoral pedicle to treat burn scars in head and neck region. Since then, it has been increasingly used in plastic Surgery. In particulary, the flap has many advantages such as long and relatively constant pedicle with large diameter, large volume of tissue which can be harvested for bulking and covering and associated low rate of complications of donor site [4]. Due to the flexible use of the flap, its use is increasingly expanded to provide tissue for deep or dead space filler, covering or reconstruction of defects in different organs. Flap can be used indifferent forms: peripheral pedicled flap (based on the collateral circulation from genicular artery) or central pedicled flap (descending branch of the circumflex femoral artery). In addition, other commonly used forms nowadays are classic free flap or thinned, chimeric or composite flaps. The flap has many advantages in reconstructive surgery for complex defectsand helps reduce the number of surgery and allows early functional and anatomical recovery The purpose of this study was to assess the initial results of ALT flap in the treatment of the lower limb defects.

2. SUBJECTS AND METHODS

2.1. Subjects: Twelve patients (12 soft tissue defects), aged 21-62, male/female 4/7, were operated using different types ALT flaps from 8/2014 to 8/2015.

2.2. Methods

Study design: uncontrolled descriptive prospective clinical study

Research protocol: thorough clinical exam, clinical and radiographic evaluation of the lesions, reconstruction planning, flap selection, surgery, follow-up and evaluation.

Results were evaluated based on the following criteria: flap survival, wound healing, functional and esthetic results at donor and recipient sites. We classified short- and long-term results using a 4-level scale.

Corresponding author: Le Hong Phuc, email: phucbstmhue@gmail.com
DOI: 10.34071/jmp.2019.3.6
Received: 2/7/2018, Resived: 11/1/2019; Accepted: 4/6/2019

We assessed post-operative flap survival which was also short-term results of surgery using the following criteria:

+ Flap color

+ Flap cappilary refill

+ Doppler ultrasound signal

- With the forementioned criteria, we classified the results as:

+ Good: Flap is evenly pink with good capillary refill and good doppler signal of vascular pulsation.

+ Fair: Flap is mostly pink with a only a small blue part at the periphery of the flap (< 20% flap surface), good capillary refill, good doppler signal of vascular pulsation.

+ Average:

Flap is slightly blue or part of the flap is blue (< 30% surface), bad capillary refill, audible but unclear and irregular doppler signal.

+ Bad: > 50% surface of the flap is blue, bad capillary refill, difficultly audible or non-audible doppler signal.

- Evaluation time:

+ Postoperative day 1, 2 and 3

+ 1 week post-op

- Long-term results were assessed by: flap color, flap quality, scar around the flap, scar formation, functional and esthetic results of donor and recipient sites. It was further classified using also a 4-level scale:

Good: soft but pressure-resistant flap, goodesthetic results (flap shape fits recipient site), no ulcer, no inflammation or infection; soft scar at donor site, normal contraction-relaxation activity of quadriceps, normal joint mobility.

Fair: Good scar formation at recipient site, bulky flap, excessive size of flap is of minor degree and acceptable by patients, hypertrophic but soft scar at donner site, normal contraction-relaxation activity of quadriceps, normal joint mobility.

Bad: Infection, inflammation, retracting scar which limit mobility and necessitate an additional procedure; hypertrophic scar, reduced contraction-relaxation activity of quadriceps, slightly reduced joint mobility.

Failure: Flap is necrotic or sclerosed, hypertrophic, ulcerated, or suffered from persistant inflammation which require re-operation; hypertrophic or incorrect scar at donor site, reduced contraction-relaxation activity of quadriceps, abnomal joint mobility.

Evaluation time: 1 month, 3 months, 6 months after the operation.

3. RESULTS

3.1. General characteristics

- Causes: The majority of the lesions was the result of trauma (7/12). Other causes included burn (1 case), osteomyelitis (1 case), firearm injury (1 case), vegatato-ulcerative lesion of upper third leg stump (1 case) and fasciocutaneous and tendons necrosis following snake bite (1 case).

- Location: around the knee joint (2 cases), upper third leg (2 cases), lower third leg (4 cases), heel (2 cases) and dorsal foot (2 cases).

- Characteristics of the defect: simple soft tissue defect (2 cases), associated with osteo-articulation infections (4 cases), associated with fascial lesions (3 cases), associated with bony lesions (2 cases) and leg stump ulcer (1 case).

3.2. Characteristics of flaps: 2 cases with simple cutaneous distal based pedicled flap for simple defects; 1 case with myo-fascio-cutaneous pedicled flap providing muscle for deep space filling, fascia for flexor tendon reconstruction and cutaneous paddle for surface coverage after grade IIIB the lower third leg opened fracture, 6 cases with vastus lareralis myocutaneous flaps for deep space and surface combined defect coverage following osteomyelitis treatment, 4 cases with fasciocutaneous flap for surface defect coverage.

- Pedicle composition: 1 artery and 2 venea commitantes (11/12 cases), 1 artery and 1 vena commitante (1/12 case)

- Type of perforator: Septocutaneous perforator of descending branch of lateral circumflex femoral artery (2/12 cases), musculocutaneous perforator (10/12 cases). In all cases, preoperative mapping of perforator was compatible with intraoperative findings.

3.3. Treatment results: Flap survival (12/12). Short-term results after one month: classified as good (11/12) and average (1/12). No special complications was noticed at donor site. 2/12 cases showed slight paresthesia at donor site. Primary closure at donor site was possible in all 12 cases. Some illustrating images:

Case 1. Nguyen Xuan Ch, YOB 1994.

Figure 1.1. Fasciocutaneous defect around the knee joint, perforator mapping with Doppler and peripheral pedicled flap planning

Figure 1.2. Follow-up after 3 months of a patient with distal based pedicled ALT flap showed good results at donor and recipient sites

Case 2. Nguyen Van T, 49T, soft tissue defect following grade IIIB open fracture

Figure 2.1. Defect associated with bone loss, lower third leg open fracture and ALT designed

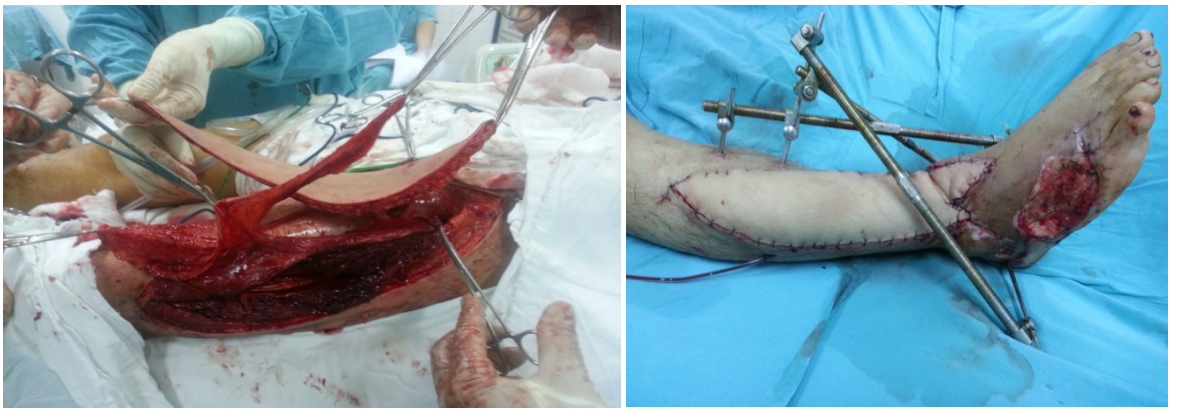

Figure 2.2. Composite ALT flap being harvested and post-operative results of reconstruction

Figure 2.3. Follow-up after 3 months with good results at donor and recipient sites

4. DISCUSSION

Considering peripheral pedicled flap, ALT flap does not only receive blood supply from perforator of descending branch of lateral circumflex femoral artery but also from laterosuperior genicular artery distally in case of lesions from lower third thight to upper third leg, especially defects around the knee joint. The application of ALT flap in the treatment of lesions from lower third thigh to upper third leg has been reported in a number of studies of authors from Taiwan, China, Japan and Korea. Chen CY (2007) reported treatment of post-burn defects in the knee region by retrograde flap. This type of flap was used by Zhao Y and other Vietnamese authors to repair scar in the knee joint and upper third leg region. This distal based pedicled ALT flap was even used to cover the defect at donor site after harvesting of a large ALT flap for reconstruction of other body parts. In our study, we permanently clamped the central pedicle to test the blood supply capacity of peripheral pedicle before harvesting. This clamping trial showed satisfied blood supply, therefore, we didnot perform microvalcular anastomosis with proximal pedicle. Esthetic and functional results were correct at both sides.

ALT flap is also used by plastic surgeon for soft tissue defects in the leg and foot. The indication for flap in this region is more limited compared to head and neck region [5,6]. The defect is usually due to burn, tumor and especially trauma. Moreover, as the poor-blood-suply skin is the only barrier to underlying bone and fascia, lesions in this area expose the patient to a significant risk of hard-to-heal, easy-to-be-infected defects.

Therefore, a large and well-vascularized flap is necessary to cover the infectious lesion. In the majority of cases, free flap is used. Its versality is useful in one-stage reconstructive procedure. Particularly with complex defects, complex flap is required to cover and to provide muscle for deep/dead space filler of various tissue losses (fascia, bone). Min Jea Lee (2012) used ALT under the form of myocutaneous flap with the success rate of more than 90%. When compared with fasciocutaneous

flap, there was a lower risk of perforator injury but the difference was not statistically significant [9]. In our study, we used 5 vastus lateralis myocutenous flap to fill dead space and cover the missing surface after debridement of infected bone with good results.

In 2000, Lee J. W et al reported 3 cases of reconstruction of Achilles tendon and soft tissue defect using ALT flap combined with fascia lata showing good outcomes. Jeng Seng-Feng et al also published 2 similar cases with a follow-up time 9 months-2 years with satisfied results, reduced hospitalization time and good recovery of limb function [6, 10, 11]. In 2012, Wong Chin-Ho et al published a series of 7 cases with reconstruction of large soft tissue defects associated with bone lesion using vastus lateralis myocutenous flap with good long-term results [12]. We applied the same techniques used by Lee J.W. (2000) in our 4 cases [9]. Furthermore, Houtmeyer Ph et al reported the results of reconstruction of Achilles tendon, tendons of extensor digitorium and soft tissue defect using pedicled ALT flap combined with fascia lata in 6 cases. The successful application of complex flap in the repair of complicated soft tissue defects can help reduce the number of surgery, hospitalization length, facilitate quickly recovery of the anatomy and function of the limb. It is also the current trend in plastic surgery for complex defects.

Considering flap complications and treatment results, a meta-analysis on 42 studies from different centers and nations by Jessica Collins MD in 2012 showed the most frequent complication being paresthesia at the donor site [7]; we had 2 cases with this type of complication. However, more patients with longer follow-up are needed to draw exact conclusion. Besides, the conservation of femoral nerve and muscles during dissection and not-too-tight skin closure will help reduce complications at donor site. In these 2 cases, we harvested large flapsmeseared >20% of thigh circumference. The extensive dissection can damage lateral femoral cutaneous nerve. Excessive pressure during skin closure also limited wound healing.

5. CONCLUSION

Free or pedicled ALT flap can be used very flexibly with high success rate. Preoperative perforator mapping can be performed with high accuracy (12/12). Free complex ALT flap is a good solution for major soft tissue defects in the lower limb.

REFERENCES

1. Phạm Thị Việt Dung, Trần Thiết Sơn (2011), "Tính linh hoạt của vạt đùi trước ngoài trong phẫu thuật tạo hình", Y học thực hành, Số 8 (777), tr 8-11.

2. Trần Đăng Khoa, Trần Thiết Sơn, Phạm Đăng Diệu, Phạm Thị Việt Dung (2010), "Nghiên cứu đặc điểm giải phẫu ứng dụng động mạch mũ đùi ngoài trên người Việt nam", *Tạp chí Y học TP Hồ Chí Minh,* Số 14, tr 163-173.

3. Nguyễn Đình Minh, Trần Thiết Sơn (2010), "Tạo hình các khuyết phần mềm chi dưới bằng vạt đùi trước ngoài", Tạp chí Y học Việt Nam, Số 2(274), tr. 432-435.

4. Chrisovalantis Lakhiani, Michael R. Lee, Michel Saint-Cyr (2012), "Vascular Anatomy of the Anterolateral Thigh Flap: A Systematic Review", *Plastic and Reconstruction Surgery*, 130(6), pp. 1254-1268.

5. Fu-chan Wei, Vivek Jain, Naci Celik, Hung-chi Chen, David Chwei-Chin Chuang and Chih-hung Lin (2003), "Have We Found an Ideal Soft-Tissue Flap? An Experience with 672 Anterolateral Thigh Flaps", *Plastic and Reconstructive Surgery*, 109 (7), pp. 2219-2226.

6. Houtmeyers Philippe et al (2012), "Reconstruction of the Achille Tendon and overlying Soft Tissue by Free Composite Anterolateral Thigh Flap with Vascularized Fascia Lata", Journal of Reconstr Microsurgery, 28, pp. 205-210.

7. J Collins, O Ayeni, A Thoma (2012), "A systematic review of anterolateral thigh flap donor site morbidity", *Can J Plast Surg,* 20(1), pp. 17-23.

8. Wolff K.D, Hölzle. F. (2005), "Anterolateral Thigh/Vastus Lateralis Flap", *Raising of Microvascular Flaps*, pp. 41-65.

9. Lee Min Jae, Yun In Sik, Rah Dong Kyun, Lee Won Jai (2012), "Lower Extremity Reconstruction Using Vastus Lateralis Myocutaneous Flap versus Anterolateral Thigh Fasciocutaneous Flap", *Arch Plast Surg, 39,* pp. 367-375.

10. Yur-Ren Kuo, Seng-Feng Jeng, Mei-Hui Kuo, Yi-Tien, Liu, Ping-Wen Lai (2002), "Versatility of the Free Anterolateral Thigh Flap for Reconstruction of Soft-Tissue Defects: Review of 140 Cases", *Annals of Plastic Surgery*, 48 (2), pp. 161-166.

11. Yur-Ren Kuo, Mei-Hui Kuo, Wen-Chieh Chou, Yi-Tien, Liu, Barbara S. Lutz, Seng-Feng Jeng (2003), "One-Stage Reconstruction of Soft Tissue and Achilles Tendon Defects Using a Composite Free Anterolateral Thigh Flap With Vascularized Fascia Lata: ClinicalExperience and Functional Assessment", *Annals of Plastic Surgery*, 50 (2), pp. 149-155.

12. Wong Chin-Ho, Ong Siang Yee, Wei F.C (2012), "The Anterolatero thigh - Vastus lateralis conjoint flap for complex defects of the lower limb", *Journal of Plastic, Reconstructive and Aesthetic surgery, 65, pp. 235-239.*