ORIGINAL ARTICLES

The application of thin flap repairing method after reascularization in femoral anterolateral free flap

Youming Pang*, Wu Li

Department of Hand and Foot Surgery, Baogang Hospital, Baotou, Inner Mongolia, China

Received: March 20, 2018 **Accepted:** April 30, 2018 **Online Published:** June 10, 2018
DOI: 10.14725/dcc.v5n2p15 **URL:** http://dx.doi.org/10.14725/dcc.v5n2p15

Abstract

Objective: To summarize the application and effect of thin flap repairing method after reascularization in femoral anterolateral free flap.
Methods: From May 2013 to October 2015, 20 cases of patients received femoral anterolateral free flap transplantation, with the flap transported to the recipient site. After reascularization, the phase I of thin flap repairing was performed in each "vein type" area. Among those, there existed 8 cases of direct suture in the donor site, and 12 cases of skin transplantation by intermediate split thickness skin graft.
Results: All the postoperative flaps survived, with 2 cases of vascular crisis and 2 cases of poor venous return at the edge of flap. No complications such as flap infection and necrosis occurred. Wounds and incisions in donor and recipient sites were healed in phase I. 20 cases of patients had been followed up for 5-24 months, and the average follow-up time was 15 months. The skin texture of flap was similar to the surrounding skin, with good abrasion resistance, no ulceration and no phase II flap repairing; the sensation of flap recovered to S3-S4 level; the two-point discrimination was 3.5-6.0 mm, with the average value of 5.0 mm. The function of patients' fingers recovered well without any complications such as contracture and deformity etc. In the last follow-up, Testative Evaluation Standard of Upper Limb Function, which was established by Chinese Medical Society for Surgery of Hand, was used to assess efficacy, and the evaluation results were as follows: excellent in 9 cases, good in 5 cases, fair in 6 cases; in accordance with the evaluation criteria listed in Michigan Hand Outcome Questionnaire (used to assess patients' satisfaction with the appearance of flaps after operation, and the results were as follows: very satisfactory in 9 cases, satisfactory in 9 cases, and moderate in 2 cases.
Conclusions: After reascularization in femoral anterolateral free flap grafting, phase I of thin repairing has small effects on flap vascularization, with a satisfactory appearance of the flap.

Key Words: Femoral anterolateral free flap, Reascularization, Thin flap repairing

Since femoral anterolateral free flap was reported firstly by Xu etc.,[1] it was preferred by surgeons clinically due to some characteristics such as its constant vascular and perforated anatomy, simple operation, long pedicle, large diameter easy for free anastomosis, concealed donor sites and less effects on the function and appearance. The type of flap has become the most common flap used in the wound repair in Department of Traumatic Orthopedics, Department of Hand And Foot Surgery and Department of Plastic Surgery.[2] However, the femoral subcutaneous fat is considerably thick, especially in women. The flap after transplantation is of no good contour, which affects the appearance of the affected limb and requires another surgery for thin repairing in the later stage. From May 2013 to October

*Correspondence: Youming Pang; E-mail: dcc72@ncspress.com; Address: Department of Hand and Foot Surgery, Baogang Hospital, Baotou, Inner Mongolia, China.

2015, in 20 cases of femoral anterolateral free flap transplantation, the flap was transplanted to the recipient site, with the phase I of thin repairing conducted in each "vein type" area after reascularization. All flaps survived after operation, with a good contour. Now it was reported as follows.

1 Data and methods

1.1 General information

The group consisted of 20 cases, including 9 males and 11 females. They were aged from 19 to 45 years, and the mean age was 30 years. Causes of injury were as follows: 8 cases of burn and scald injuries, 10 cases of crush injuries and 2 cases of infection caused by trauma. All cases showed skin defects on the ankles of feet and hands, including 5 cases of skin defects on the palm, 3 cases on the back of the hand, 4 cases on the heel of the foot, and 8 cases on the back of the foot and on the dorsal part of the wrist. The size of skin defect ranged from 3.0 cm × 7.0 cm to 8.0 cm × 19.0 cm. The time interval from injury to surgery ranged from 2 h to 14 d, with an average of 9 d. There existed 8 cases of direct suture in donor site, and 12 cases of skin transplantation by intermediate split thickness skin graft.

1.2 Surgical methods

1.2.1 Preoperative preparation

Wound debridement by VSD was performed in this group in phase I, and in phase II, femoral anterolateral free flap was repaired. It was required to control infection before operation, and female patients couldn't receive any surgery until their menstrual period had been over for 4-14 d, so as to increase systemic nutrition and avoid increasing the risk of surgical and postoperative infection under physical consumption. Ultrasonic Doppler blood flowmeter was used to detect the perforation of cutaneous branches in the donor site, in order to improve the success rate of operation.

1.2.2 Flap design and incision

A suitable and appropriate femoral anterolateral flap was required to be designed according to size, shape and depth of the defect wound and the damage degree of the fascia and the muscle (tendon). After wound debridement, a piece of gauze was trimmed into wound sample cloth for the use of flap design. The size of flap should be 10% larger than that of the wound. In accordance with the principle of point-line-plane, the key point was the midpoint between the anterior superior spine and the lateral upper border of patella. Plotted a circle (3.0 cm) with this midpoint as the center, and ultrasonic Doppler blood flowmeter was used within the circle to detect the perforation of cutaneous branches. As to the line, which was made between the midpoint of the inguinal ligament and the key point, the lower 2/3 part of the line was the surface projection of the descending branch of the lateral circumflex femoral artery. The flap pedicle incision was made along the surface projection of the vascular pedicle. Enlarged the space between the rectus femoris and the vastus lateralis muscle, and pulled the rectus muscle and the vastus lateralis muscle to both sides, in order to locate the descending branch of the lateral circumflex femoral artery on the superficial plane along the space between the rectus femoris and the vastus lateralis muscle. Made an anatomy to the distal part along the descending branch, to expose the first myocutaneous artery perforator and the distal terminal part of the descending branch. Freed the skin flap and observed the blood circulation of the flap. Reserved the proximal and distal vessels of the descending branch to the greatest extent and cut off the vessels. The wound surface was covered by the flap, and the distal and proximal ends of the descending branch were sutured to the distal and proximal ends of the main vessel in the wound surface respectively, so that the skin flap could play the role in reconstructing the main vessel in the wound surface and covering the wound.

1.2.3 Thin flap repairing

After the femoral anterolateral flap was transplanted to the recipient site and the artery and the vein were sutured, the blood supply was maintained for 10-15 min. Under this condition, the flap was flipped and placed under the 5 × microscope to carefully observe the position where the blood vessel of the skin flap passed into the flap from the pedicle and its tracks. According to the distance between each part of the skin flap and the vascular pedicle, the flap was divided into zone A (the distal area of the vascular pedicle), zone B (the proximal area of the skin flap) and zone C (the peripheral area of the vascular pedicle). Different repairing methods were applied to different zones: subcutaneous adipose tissues in zone A were required to be removed to the subdermal vascular network layer as many as possible; adipose tissues in zone B should be partially reserved; as zone C was in proximity to the vascular pedicle, subcutaneous adipose tissues on the part which was closer to the pedicle should be reserved as much as possible. Along the main branches of the vessel, "stepped" thin repairing was made from the pedicle base to the edge of the flap, with 1.0-3.0 mm of subcutaneous fat reserved. Observed the blood circulation while thin repairing was performed, and the branch cut off was ligatured with 3/0 undamaged sutures. The defect in pedicle base of femoral fascia in the donor site of the flap was sutured by way of direct suture. There existed 8 cases of direct suture in skin defect, and 12 cases of skin transplantation by intermediate split thickness skin graft. Meanwhile, the drainage was placed routinely.

 ISSN 2375-8449 E-ISSN 2375-8473

1.2.4 Postoperative treatment

All patients were equipped with analgesic pumps after operation, and plaster supports or external fixators were used for functional fixation. After operation, the fluid was supplemented, with 3,000-5,000 ml of intravenous infusion. Anti-infection, anti-vasospasm, anti-coagulant drugs were given for 7-14 d. Strictly and closely observe the color and the temperature of the flap, and continuous lamp-baking was performed for keeping warm.

2 Results

20 cases of patients had been followed up for 5-24 months, and the average follow-up time was 15 months. All flaps survived without any complications such as necrosis of the flap edge, infection etc. Wounds and incisions in the donor and recipient sites were healed in phase I, with a good appearance of the flap. The skin flap is similar to the peripheral skin in texture, with good abrasion resistance. All cases were not given phase II thin flap repairing. The sensation of flap recovered to S3-S4 level; the two-point discrimination was 3.5-6.0 mm, with the average value of 5.0 mm; The function of patients' fingers recovered well without any complications such as contracture and deformity etc. (see Figure 1). In the last follow-up, Testative Evaluation Standard of Upper Limb Function, which was established by Chinese Medical Society for Surgery of Hand,[3] was used to assess efficacy, and the evaluation results were as follows: excellent in 9 cases, good in 5 cases, fair in 6 cases; in accordance with the evaluation criteria listed in Michigan Hand Outcome Questionnaire (used to assess patients' satisfaction with the appearance of flaps after operation),[4] and the results were as follows: very satisfactory in 9 cases, satisfactory in 9 cases, and moderate in 2 cases. The thin repairing time of the skin flap was 30-60 min, with an average of 42 min. The amount of blood loss in the course of thin repairing was 40-150 ml, with an average of 100 ml. 2 cases of postoperative vascular crisis occurred, the symptoms were relieved after surgical exploration and local application of papaverine. 2 cases of poor venous return at the edge of flap occurred, with no blisters. All symptoms were relieved in a week after operation.

3 Discussion

3.1 The anatomical features of femoral anterolateral flap

According to the anatomical research conducted by Sananpanich etc.[5] on vessels of femoral anterolateral free flap, the proximal diameter was 2.2-4.0 mm (3.0 mm on average), the distal diameter was 0.9-1.8 mm (1.3 mm on average), and the length from the branch to the flap was 11.0-19.0 cm (16.5 cm on average). The vascular and perforated anatomy of femoral anterolateral free flap is relatively constant, and the vascular pedicle has the characteristics of large caliber and long length, so it can meet the requirements of repairing the damaged vessels and reconstructing the blood circulation of limbs. However, there were some patients with abnormal tracks of blood vessels. If high cutaneous branches were found during the operation, the wound would be covered with myocutaneous flap. The skin grafting would be performed after myocutaneous flap survived.

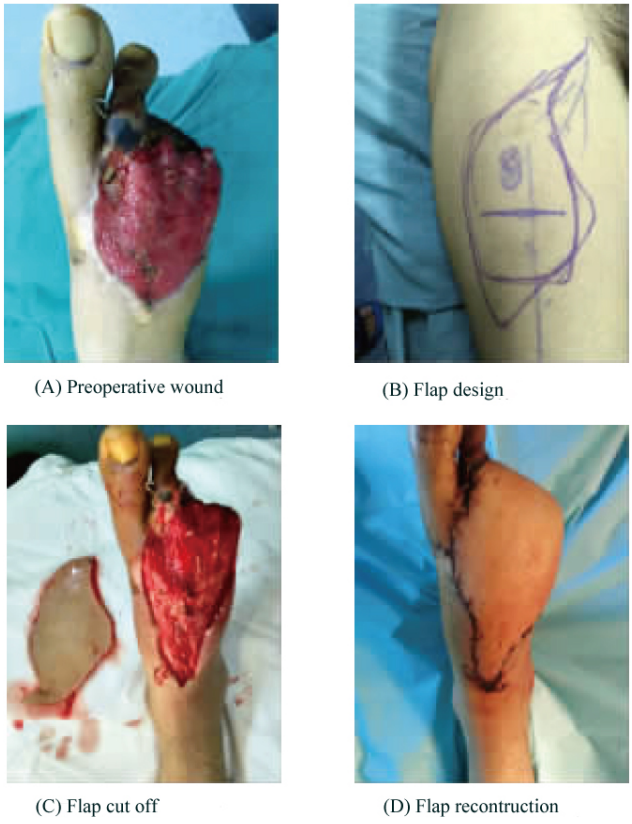

Figure 1: Flap repairing process

3.2 Free skin flaps adopted to bridging technology

Free skin flaps adopted to bridging technology include femoral anterolateral radial artery flaps, scapular flaps and calf flaps. The advantage of radial artery flaps is that cutaneous branches are abundant and the vascular pedicle is long, but a primary blood vessel is sacrificed and the skin flap to be incised is small in size. The radial artery flap has a great effect on patients' appearance and their feelings. The scapular flap is in a concealed position, with a long vascular pedicle, abundant cutaneous branches. It can take along the bone flap. The blood supply comes from the subscapular artery - the circumflex scapular artery - the thoracodosal artery. However, because of poor compliance, patients are required to use the lateral position and change positions dur-

ing operation, resulting in the prolonged operation time. As to the femoral anterolateral flap, the skin flap to be incised is large in size, and the texture is in proximity to the skin in the recipient site. The blood supply comes from non-primary blood vessels of limbs and trunk, and the anatomical position is constant, and the donor site is relatively concealed, so that the flap incision has a slight effect on the function and appearance of the donor site.[6] The type of technique becomes the most used in clinical practice. According to the damage degree of the recipient site, it is feasible to incise the fascial flap, the fascial skin flap or the perforator flap simply, those flaps can also take along part of vastus lateralis muscle for the incision of musculocutaneous flap.[7] Although the femoral anterolateral free flap is widely used in clinical practice, the postoperative swelling of the flap brings the patients with poor appearance and the inconvenience for future thin repairing. In this study, a new method for the thin repairing of free skin flap was used after the suture of the artery and the vein in the recipient site under the condition of the blood circulation. After reascularization, the arteriovenous blood circulation can be clearly observed from the flap pedicle, with the pedicle base and adipose tissues of the pedicle reserved. According to the distance between each part of the skin flap and the vascular pedicle, the flap was divided into zone A, zone B and zone C. Zone A is farthest from the flap pedicle. In this zone, subcutaneous adipose tissues were required to be removed to the subdermal vascular network layer as many as possible. Subdermal vascular plexus in the femoral anterolateral area is so well-developed that the subdermal veins can anastomosize in plexus and drain into the accompanying veins of the musculocutaneous perforator or into the femoral anterolateral superficial veins even if the distribution of fascia perforator is lack. It is a dominant circulation of the flap,[8] and the circulation of the blood supply is not influenced by the thin flap repairing. Zone B is closer to the vascular pedicle in comparison with zone A, and it gets the thin repairing usually under the 10 × microscope, with part of adipose tissues reserved. If too many adipose tissues were eliminated, the blood-supply area of the perforator vessel would be reduced consequently. Meanwhile, it would lead to the disorder of venous return in the flap, even the occurrence of flap necrosis.[9] Zone C is in proximity to the vascular pedicle and it is required to reserve subcutaneous adipose tissues as many as possible. The protection of the vascular pedicle and the subcutaneous perforator network should be noted.

3.3 Intraoperative considerations

Although the ultrasonic Doppler blood flowmeter can be used to approximately locate the vascular pedicle and the perforation of cutaneous branches before operation, the vascular anatomy varies among individuals, so that unavoidable differences may appear during the operation even if the preoperative flap design is reasonable. The author gets used to making an incision at the edge of the flap, and carefully separates it from bottom to top along the femoral fascia. Firstly, expose several main perforators in the skin flap, and then follow the perforators to locate the descending branch of the lateral circumflex femoral artery in the primary vessle at the proximal end, in order to clearly expose the anatomical relationship between perforators and the vascular pedicle. Combined with the location of perforators and the perforator with large diameter, the incised flap is readjusted during the operation. When it is intended to incise the lobulated flap, the flap perforator is located in the center of the flap to the greatest extent. In the course of thin repairing, it is required to operate under the microscope in the case that the undivided pedicle is equipped with the blood supply. Thin repairing is performed at the edge of the flap, but the area where the perforator passes into the flap is treated less, with 2.0-3.0 cm (width) of femoral fascia leaved and 5.0-10.0 mm (thickness) of adipose tissues reserved. Taking the area as the center, the thin repairing is performed to the peripheral area. Meanwhile, protect visible vascular network in the fat layer to the greatest extent.[10]

Above all, after reascularization in femoral anterolateral free flap grafting, phase I thin repairing is suitable for the defects in the thin skin on the ankles of feet and hands. This surgical method can bring about a satisfactory appearance and shorten the vascular ischemia time; thin repairing can be performed after vascular anastomosis and reascularization under the condition of blood circulation, and the irrigation scope of the blood circulation can be clarified. The vessels in the pedicle are usually pulsed and filled well, so that it is beneficial to the thin repairing and easy identification of vascular tracks. However, vascular branches are easy to be damaged in the course of thin repairing, leading to partial necrosis or hematoma of the skin flap.

Conflicts of Interest Disclosure

The authors have no conflicts of interest related to this article.

References

[1] Xu CD, Zhong SZ, Liu MZ, et al. A new anatomically donor site for the femoral anterolateral free flap. Chinese Journal of Clinical Anatomy. 1984; 2(3): 158-160.

[2] Xie SQ, Hou JX, Zhang SJ, et al. Clinical experience of one-time wound repair of femoral anterolateral flap grafting. Chinese Journal of Clinicians (Electronic Edition). 2015; 9(21): 4034-4037.

[3] Pan DD, Gu YD, Dai D, et al. Testative Evaluation Standard of Upper Limb Function established by Chinese Medical Society for Surgery of Hand. Chinese Journal of Hand Surgery. 2000; 16(3): 130-135.

[4] Feng SM, Wang AG, Zhang ZY, et al. Improvement of first dorsal metacarpal artery flaps in the repair of thumb pulp defect. Chinese Journal of Microsurgery. 2015; 38(2): 166-169.

[5] Sananpanich K, Tu YK, Kraisarin J, et al. Flow-through antero-

lateral thigh flap for simultaneous soft tissue and long vascular gapreconstruction in extremity injuries: anatomical study and case report. Injury. 2008; 39(Suppl 4): 47-54. PMid: 18804586. https://doi.org/10.1016/j.injury.2008.08.031

[6] Li J, Zhang DW, Zhu YG, et al. Flow-through anterolateral thigh flap for reconstruction of vast soft tissue defect combined with segmental main artery defects in lower extremities. Journal of Clinical Orthopaedics. 2015; 18(1): 87-92.

[7] Zhang WY, Lin S, Hu YX, et al. Clinical application of free superthin anterolateral femoral perforator flap. Chinese Journal of Microsurgery. 2010; 33(1): 9-11.

[8] Fang BR, Sun Y, He JY, et al. Application of abdominal venous angio-architecture in flap thinning of deep inferior epigastric artery perforator flap. Chinese Journal of Plastic Surgery. 2015; 31(5): 360-364.

[9] Yu DZ, Fang BR, Tang HR, et al. Improved anatomical study in posterior tibial artery perforator flaps. Chinese Journal of Microsurgery. 2015; 38(4): 372-376.

[10] Tan B, Yang L, Yang LC, et al. Ultrathin free anterolateral thigh flap for repairing tissue defects in the dorsum of foot. Journey of Practical Hand Surgery. 2015; 29(4): 376-377.