p-ISSN 1859 - 3461
e-ISSN 3030 - 4008

APPLICATION OF DISTALLY BASED ANTEROLATERAL THIGH FLAP IN A KNEE SOFT-TISSUE DEFECT RECONSTRUCTION

(CASE REPORT)

Tong Thanh Hai, Do Trung Quyet✉, Nguyen Ngoc Chiu, Cao Trung Kien, Vu Quang Vinh

Le Huu Trac National Burns Hospital

SUMMARY

Bone-exposed knee defects are a challenge for surgeons in choosing an appropriate reconstruction method. Distally based anterolateral thigh flap is a top option due to its texture and color which are quite similar to the knee region, its large size, and its sufficiently long pedicle. We report a clinical case of using a distally based anterolateral thigh flap in the reconstruction of a large soft tissue defect around the knee with exposed patella due to high-voltage electrical burns. The outcome is complete flap survival and good functional recovery, the flap donor site is covered by a split-skin graft, which heals during the early stages of healing.

Keywords: *Knee soft-tissue defect, distally based anterolateral thigh flap*

1. CASE REPORT

1.1. Patient information

A 33-year-old male patient, with no significant past medical history, suffered a high-voltage electrical burn due to a work accident, was treated at a local hospital, and transferred to Le Huu Trac National Burn Hospital on the third day of illness. The burn injury caused a wound in the right knee region exposing the patella, not affecting the joint. He was treated by transferring the medial sural artery perforator flap into the soft defect of the knee region on the nine days of illness. However, the flap was necrosis apart in the distal part, still exposing the patella, with an 8 x 8 cm dimension.

Figure 1.1. A soft tissue defect exposing the right patella, size 8 x 8 cm

1.2. Flap selection and design

On the 14th day of illness, the debridement of necrotic tissue and the

[1]Chịu trách nhiệm: Đỗ Trung Quyết, Bệnh viện Bỏng Quốc gia Lê Hữu Trác

Email: doquyet.vmmu@gmail.com

Ngày gửi bài: 05/12/2024; Ngày nhận xét: 12/12/2024; Ngày duyệt bài: 26/12/2024

https://doi.org/10.54804/

p-ISSN 1859 - 3461
e-ISSN 3030 - 4008

necrotic patella in the right knee wound was taken. The size of the defect region after debridement is approximately 10 x 15 cm.

After debridement, the ipsilateral distally based anterolateral thigh flap was used to cover the right tissue defect region. The flap is located in the anterolateral thigh, the axis of the flap is determined by a straight line connecting the right anterior superior iliac spine and the superior lateral point of the ipsilateral patella. The flap is nourished by the perforating branch of the lateral femoral circumflex artery and venae comitantes. The perforator vessel is identified by hand Doppler within the mid-range of the above-mentioned straight line. Design a 16 x 10 cm anterior lateral thigh flap, located about 20 cm from the upper edge of the lesion.

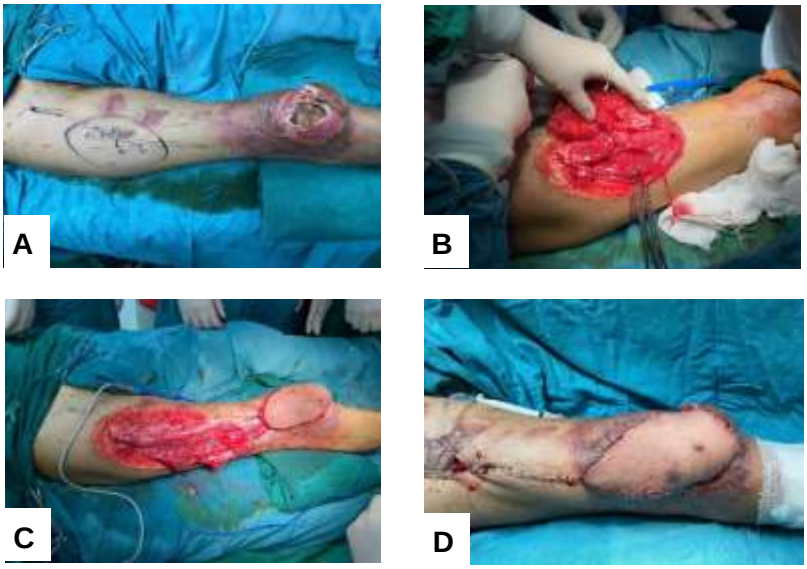


Figure 1.2. A: Design a distally based anterolateral thigh flap, size 16 x 10 cm. B: Dissection of the flap to find and ligate the proximal descending branch of the lateral femoral circumflex artery. C and D: Rotate the flap to cover the defect and fix it with sutures.

1.3. Dissection and flap transfer

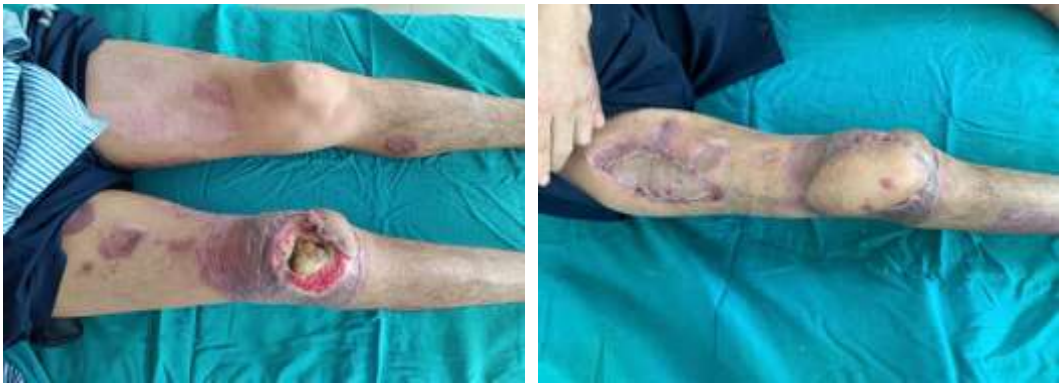
Perforator vessels dissection: Making an incision in the skin, dissecting from the outer edge inward, two branches penetrated the flap at the marking position. These penetrating branches were dissected from surrounding tissues to be free mobile. The dissection process was very meticulous and careful because the penetrating branches had small diameters. We used Lidocaine for irrigation to avoid vessel spasms and used hand Doppler to check regularly.

Vascular pedicle dissection: Dissection from the identified perforating branch up to its origin, divided from the descending branch of the lateral femoral circumflex artery. The descending branch of the lateral femoral circumflex artery was clamped near its origin, and the flap edge was found to be oozing blood evenly. The proximal vascular pedicle is ligated and cut. Dissecting the distal vascular pedicle, taking a part of the vastus lateralis muscle to increase the flexibility of the vascular

pedicle. The flap vascular pedicle after dissection is about 15 cm long.

Flap transfer to cover the soft tissue defect: Rotation of the flap to cover the bone-exposed defect in the knee region, fix it with sutures, and place a drain under it. The flap donor site was covered with a split-thickness skin graft.

The flap survived completely, the donor site was healed at the early stage of healing. The patient was discharged 10 days post-operation.



Pre-operation 8 days Post-operation

Figure 1.3. Images of the wound before and after surgery

2. DISCUSSION

2.1. Surgical methods for treating bone-exposed wounds in the knee region

Bone-exposed knee defects are complex wounds, for large defects that cannot be closed with sutures, other reconstructive methods such as flaps are required.

The local fasciocutaneous flaps of the knee are the first choice to be considered due to their similarity in color and texture to the knee area. However, these flaps can be damaged in cases of extensive knee defects. The lateral superior and medial superior genicular artery perforator flaps are limited in size and rotation arc which are not enough to cover large defects around the knee. The medial sural artery perforator flap can also be applied.

Although it does not damage the gastrocnemius muscle, the saphenous nerve is always sacrificed. Moreover, this flap cannot cover a large defect [1]. In this patient, a medial sural artery perforator flap was used, however, there was partial necrosis of the distal end.

Pedicled muscle flaps are the first choice for covering knee defects, especially in cases of knee injuries with exposed bone and joints. However, the vastus lateralis and gastrocnemius flaps are quite cumbersome, and the mobility impairment after transferring the flap is significant, and the flap pedicle is also quite short when covering anterior knee defects [2].

The use of free flaps such as the anterolateral thigh flap, latissimus dorsi muscle flap, etc. is not always preferred in this area due to the high rate of leaving defects at the donor site, long surgical time, and difficulty in selecting appropriate recipient blood vessels located deep around the knee area [3].

p-ISSN 1859 - 3461
e-ISSN 3030 - 4008

2.2. The application of distally based anterolateral thigh flap in a knee soft-tissue defect reconstruction

2.2.1. Anatomical basis

Distally based anterolateral thigh flap was first described by Zhang. G in 1990 [4], and then the anatomical basis and feasibility of the flap were clearly demonstrated. Studies on the anatomy and hemodynamics of the distally based anterolateral thigh flap were published by Pan.S et al. in 2004 [5], Yamada.S et al. in 2014 [6].

In 2011, Demirseren. M.E et al [7] reported 17 cases of using distally based anterolateral thigh flap in reconstructing injuries of the knee and upper third of the lower leg. All flaps survived and had good cosmetic and functional results. In 2017, Liu. Y et al. [8] specifically classified the types of anterolateral thigh flaps based on the origin of the perforator vessels feeding the flap from the branches of the lateral femoral circumflex artery, which has great value in clinical practice.

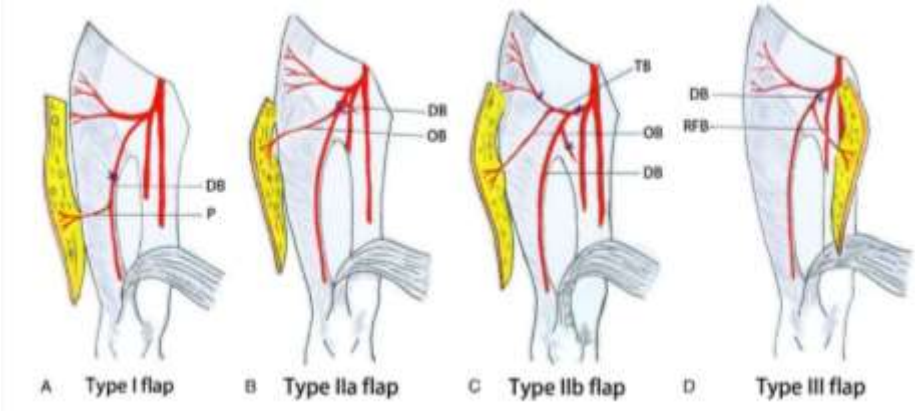


Figure 2.1. Classification of distally based anterolateral thigh flap according to Liu. Y et al. DB: Descending branch of the lateral circumflex femoral artery, TB: Transverse branch; OB: Oblique branch arising from the descending or transverse branch of the lateral circumflex femoral artery, RFB: Rectus femoris branch arising from the descending branch of the lateral circumflex femoral artery

According to Liu. Y et al, there were three different types of distally based anterolateral thigh flap: the type I flap was based on perforating vessels originating from the lateral circumflex femoral artery descending branch (Fig. 2.1A). The type II flap was subdivided into type IIa and type IIb, which were based on the perforating vessels of the oblique branch from the descending and transverse branches of the lateral circumflex femoral artery, respectively (Figs. 2.1B, C). The type III flap was based on the perforating vessel of the rectus femoris branch from the lateral circumflex femoral artery descending branch (Fig. 2.1D).

2.2.2. Advantages and disadvantages

a) Advantages

Gravvanis. G., et al. [9] demonstrated that the use of distally based anterolateral thigh flaps for knee reconstruction is superior to gastrocnemius muscle flaps:

- Large size: in the report of Yamada.S et al., the flap length was 9 - 23 cm, the flap width was 7 - 14 cm (the largest flap size was 14 x 23 cm) [6]. In our clinical case, it was 10 x 16 cm.

- The flap pedicle is long enough to cover anterior knee defects: The pedicle length is 14.5 - 16 cm [5].

- The flap has a moderate thickness, and the structure and color are quite similar to the knee area.

- The flap donor site is relatively convenient, with no need to sacrifice large blood vessels, and it is closed with sutures or skin grafts, covered by clothing.

b) Disadvantages

- Difficulty in dissecting the perforating branch: Due to small size of perforator vessels, a wide range of anatomical variations, especially when the flap's perforating branches bifurcate from the diagonal branches of group II according to Liu. Y., classification et al. [5], [6], [8].

- It is difficult to assess the safety of the flap before flap transfer: the distally based anterolateral thigh flap is nourished by the distal vascular pedicle, but a hand doppler can only identify the perforating branch supplied by the proximal vascular pedicle. Therefore, it is necessary to prescribe angiography for the flap donor site.

- Difficulty in covering the defect on the medial side of the knee region: The distal pedicle is relatively long, from 14.5 - 16 cm [5], but cannot reach the medial side of the knee area.

2.2.3. Technical notes

- Flap design:

Angiography before operation: Because the perforating branches of the distally based anterolateral thigh flap have many anatomical variations [5], [6], [8]. Furthermore, it is difficult to assess the safety of the flap before transferring, because this type of flap is nourished by the distal vascular pedicle.

- Flap dissection:

The dissection of the flap must be very careful and meticulous because the perforating branches piercing the flap have very small diameters [6], [7]. Clamp the proximal vascular pedicle to assess the circulation of the flap from the distal vascular pedicle. If the blood supply is safe, then use a distally based anterolateral thigh flap, otherwise, switch to another option to cover the knee defect.

- Postoperative care:

Immobilization of the knee joint with a splint: the knee joint is immobilized to ensure blood circulation through the anastomosis site, the flap nutrition is stable, and the anastomosis site is well-healing.

3. CONCLUSION

The distally based anterolateral thigh flap has flexibility and, a large enough flap size, color, and texture match, making it a suitable choice in reconstructing anterior knee joint lesions with exposed bone. However, before surgery, angiography should be prescribed to examine the anatomical characteristics of the blood vessels in the anterolateral thigh region. Surgeons must be meticulous during the dissection of the perforator vessels and must assess the nutrition of the flap from the distal pedicle before transferring the flap.

p-ISSN 1859 - 3461
e-ISSN 3030 - 4008

REFERENCES

1. Okamoto. H., et al (2007). Anatomical basis of the medial sural artery perforator flap in Asians. Scandinavian journal of plastic and reconstructive surgery and hand surgery, 41(3), 125-129.
2. Chung, Y. J., et al (2002). Reconstruction of a lower extremity soft-tissue defect using the gastrocnemius musculoadipofascial flap. Annals of plastic surgery, 49(1), 91-95.
3. Fang. T., et al (2013). Recipient vessels in the free flap reconstruction around the knee. Annals of plastic surgery, 71(4), 429-433.
4. Zhang. G., et al (1990). Reversed anterolateral thigh island flap and myocutaneous flap transplantation. Zhonghua Yi Xue Za Zhi, 70(12), 676-8.
5. Pan, S. C., et al (2004). Distally based anterolateral thigh flap: an anatomic and clinical study. Plastic and Reconstructive Surgery, 114(7), 1768-1775.
6. Yamada, S., et al (2014). Anatomical basis of distally based anterolateral thigh flap. Journal of Plastic Surgery and Hand Surgery, 48(3), 197-200.
7. Demirseren, M. E., et al (2011). Clinical experience with a reverse-flow anterolateral thigh perforator flap for the reconstruction of soft-tissue defects of the knee and proximal lower leg. Journal of plastic, reconstructive & aesthetic surgery, 64(12), 1613-1620.
8. Liu, Y., et al (2017). Classification and application of the distally-based thigh flap based on the lateral circumflex femoral artery system. Annals of Plastic Surgery, 78(5), 497-504.
9. Gravvanis, A. I., et al (2005). Medial gastrocnemius muscle flap versus distally based anterolateral thigh flap: Conservative or modern approach to the exposed knee joint? Plastic and Reconstructive Surgery, 116(3), 932-934.
10. Noreldin, A. A., Fukuta, K., and Jackson, I. T., (1992). Role of perivenous areolar tissue in the viability of venous flaps: an experimental study on the inferior epigastric venous flap of the rat. British journal of plastic surgery, 45(1), 18-2.