

Clinical Observation of Anterolateral Thigh Perforator Flap for Reconstruction of Head and Facial Soft Tissue Defects

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Abstract: *Objective:* To evaluate the efficacy of the anterolateral thigh perforator flap in repairing head and face skin defects. *Methods:* Nineteen patients with head and facial skin defects, admitted to the 303rd Hospital and the 89th Hospital of the People's Liberation Army from May 2012 to May 2020, were selected as research subjects and underwent repair surgery. The primary method employed was free transplantation of the anterolateral thigh perforator flap. Following the operation, patients were closely monitored for 5 to 7 days. The viability of the blood vessels was assessed based on the healing, color, and vascular filling of the flaps. Patients were followed up for 6 to 18 months post-operation to evaluate the donor and recipient sites. *Results:* Out of the 19 transplanted flaps, 18 survived completely, yielding a survival rate of 94.73%. The recurrence rate of the original lesion post-operation was 10.52%. 94.44% of patients reported no impact on lower limb movement on the side where the flap was harvested, and only 16.66% of patients experienced noticeable numbness in the donor site skin after the operation. All 19 patients reported that initially, the flaps were stiff and had limited movement. However, after 6 months, they gradually softened and adhered more closely to the original skin tissue. *Conclusion:* The free anterolateral femoral perforator flap is an ideal option for repairing head and facial defects. It offers a reliable blood supply, a large harvestable area, and minimal impact on both donor and recipient sites. Its abundant blood supply remains unaffected by the repair surgery, resulting in a relatively high survival rate. It demonstrates good adaptability and is more readily accepted by patients.

Keywords: Perforator flap; Head and face skin defect; Skin repair

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1. Introduction

The formation of soft tissue defects in the head and face is primarily associated with factors such as trauma and

disease. The repair treatment or surgery for these defects involves multiple clinical anatomical areas, including the skull base, maxilla, and oral cavity^[1]. Dealing with issues such as radiotherapy-induced damage, tissue excision, and infections is quite complex, necessitating the transplantation of larger tissue sections for repair. Most wounds resulting from surgery or radiotherapy are accompanied by severe tissue damage and defects, disrupting the blood circulation in the soft tissues of the wound. Simple skin grafting procedures cannot meet the repair requirements. In recent years, free tissue flap transplantation has gradually become the preferred or even the only option for such injuries^[2]. The anterolateral thigh flap (ALTF) is the most commonly used in clinical practice, offering advantages such as rapid postoperative recovery, minimal patient discomfort, high satisfaction rates, and relatively low hospitalization costs. However, conventional excision inevitably leads to issues with excessive subcutaneous fat. Consequently, the anterolateral thigh perforator flap (ALTP) was developed. Long-term clinical practice has confirmed that it can provide sufficient tissue for filling and extensive skin coverage, often serving as the preferred option for donor site flaps in many cases^[3]. With the advancement of clinical diagnosis and treatment techniques, ALTP has been effectively applied in the repair of soft tissue defects in the head and face.

Against this backdrop, this study selected 19 patients with soft tissue defects in the head and face treated at the 303rd Hospital of the People's Liberation Army and the 89th Hospital of the People's Liberation Army from May 2012 to May 2020. ALTP was used to repair the defective areas, with the aim of further exploring its clinical efficacy. The findings are reported as follows.

2. Materials and methods

2.1. General information

A total of 19 patients with soft tissue defects in the head and face were selected, including 7 from the 303rd Hospital of the People's Liberation Army and 12 from the 89th Hospital of the People's Liberation Army, from May 2012 to May 2020. Among them, there were 9 males and 10 females; ages ranged from 31 to 67 years, with an average age of (50.7 ± 6.2) years. The smallest skin defect area was 2 cm × 3 cm, and the largest was 12 cm × 10.6 cm. The distribution of defects included the nose (2 cases), cheeks (3 cases), forehead (6 cases), and temporal region (8 cases). All patients underwent head and face debridement under general anesthesia, followed by free anterolateral thigh perforator flap transplantation to repair the wound.

2.2. Research methods

Patients who have soft tissue defect on the head was positioned supine on the operating table. The general anesthesia via nasal tracheal intubation and were performed (**Figure 1**). The surgical procedures were conducted simultaneously by two teams. One team performed debridement of the head and face or excision of diseased tissue, while the other team, responsible for preparing the free anterolateral thigh flap, could commence their procedure concurrently.

Typically, the lower limb contralateral to the recipient site is selected for flap harvesting. A line was drawn connecting the lateral aspect of the patella and the anterior superior iliac spine. Additionally, the location of the perforating vessels, as determined by preoperative ultrasound Doppler, was taken into consideration. Generally, the most common distribution of perforating vessels is found within a 3 cm radius of the midpoint of the aforementioned line (**Figure 2**). The size and shape of the required flap must be designed with the point where the perforating vessels emerge from the superficial fascia as the center.



Figure 1. Preoperative soft tissue defect on the head.

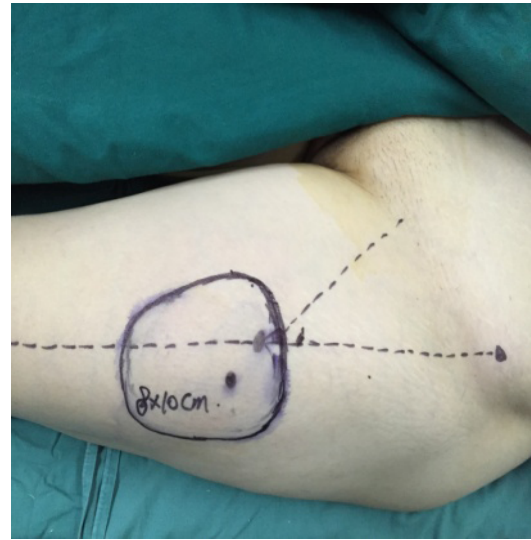


Figure 2. Design of the anterolateral thigh perforator flap.

The edge of the flap was incised to the level of the superficial fascia, and the fascia between the rectus femoris and vastus lateralis muscles was incised, with the rectus femoris muscle retracted medially. The perforating vessels were dissected from distal to proximal until reaching the descending branch of the lateral circumflex femoral artery. The neurovascular bundle of the descending branch of the lateral circumflex femoral artery was thoroughly exposed. Throughout the procedure, care was taken to protect the branches of the femoral nerve. Adjustments to the incision, management of the descending branches of the lateral circumflex femoral artery and vein, and creation of adequate operative space were made as necessary. The donor site could be closed by approximating the edges after appropriate subcutaneous undermining. The harvested flap was then used to cover the recipient site, and the axial vessels of the flap were anastomosed end-to-end or end-to-side with the previously isolated and prepared vessels at the recipient site (**Figure 3**).

High-quality vascular anastomosis was then aimed for to prevent intraoperative and postoperative anastomotic thrombosis (**Figure 4**).

The skin was sutured loosely and intermittently, with subcutaneous film drainage (see **Figure 5**).



Figure 3. Harvesting of the flap.

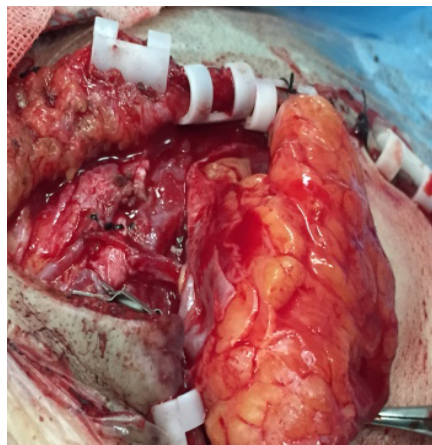


Figure 4. Vascular anastomosis (end-to-side anastomosis).



Figure 5. Skin suture.

2.3. Observation indicators

2.3.1. Definition of ideal flap survival in flap transplantation surgery

At least 7 days postoperatively, the flap exhibits good luster, temperature, blood supply, and elasticity, with no risk of vascular crisis (see **Figure 6**).



Figure 6. Postoperative recovery with good appearance.

2.3.2. Follow up

Patients were followed up for 6 to 18 months postoperatively to assess the functional impact of flap transplantation on the donor site. Follow-up methods included face-to-face interviews and telephone communication, covering four aspects: First, inquiry about the sensation at the repaired site (normal, good, or poor); second, assessment of lower limb motion restriction (severely affected, not significantly affected, or unaffected); third, evaluation of the aesthetic appearance of the scar at the donor site; and fourth, examination for significant numbness in the skin at the donor site.

2.4. Statistical processing

The obtained data were validated and processed using professional statistical software, specifically the SPSS 26.0 software package. For measurement data ($\bar{x} \pm s$) following a normal distribution pattern, the *t*-test is used; for technical or categorical data, the chi-square test (χ^2 test) is applied, with results presented as “n (%)”. A statistically significant difference between groups was indicated when $p < 0.05$.

3. Results

3.1. Postoperative flap healing

Among the 19 cases, one experienced flap margin necrosis due to early venous thrombosis at the anastomosis site, which worsened over four postoperative days, leading to impaired blood circulation. The remaining 18 transplanted flaps survived completely, yielding a survival rate of 94.73%. For the necrotic case, the residual viable flap was debrided, reshaped, and tension-relieving sutured to the original wound surface. All surviving patients' wounds met the criteria for primary healing. During the surgical procedure, skin perforators were identified in 5 cases involving the intermuscular septum and 14 cases involving the musculocutaneous perforators, accounting for 26.31% and 73.68%, respectively. All harvested free anterolateral thigh flaps exhibited distinct skin perforators. Additionally, although one case experienced vasospasm during surgery, it gradually normalized after timely intervention with papaverine injection, and the prognosis for flap survival was favorable.

3.2. Follow up results

The follow up results at 6 months showed that among the 18 patients with viable flaps, 17 reported no impact on lower limb mobility due to flap harvesting, accounting for 94.44%. Sixteen patients expressed satisfaction with the appearance; among them, 2 patients believed that the initial depression affected the overall aesthetics, but the impact gradually diminished and became barely noticeable over time. Additionally, 2 patients mentioned “large scars and poor aesthetics”. Regarding numbness at the donor site, 3 patients reported significant sensation, while the others reported minimal or no sensation. In terms of recovery at the recipient site, 3 patients with isthmus repair experienced voice changes postoperatively, but these gradually improved and returned to normal by 6 months. All surviving patients confirmed that the transplanted flaps were initially stiff and slightly restricted in movement, but they became increasingly softer over time.

4. Discussion

4.1. Requirements for an ideal flap for repairing head and facial tissue defects

The head and face are critical regions for human sensory perception, respiration, facial expressions, and swallowing, with relatively complex and unique anatomical structures. Large-area tissue defects in the head and face following trauma require repair and reconstruction. Defects in tissue or alterations in the color, texture, and shape of the repaired tissue after trauma can have an immeasurable impact on the patient’s physical and mental well-being ^[4]. Therefore, early repair of large-area defects in the head and face and restoration of the patient’s facial appearance are not only the responsibility of plastic surgeons but also pose a challenge for orthopedic surgeons ^[5].

An ideal flap for repairing head and facial tissue injuries should meet the following requirements, including as followed.

- (1) The flap preparation process should ideally not require a change in the patient’s position, be as convenient as possible, and shorten the surgical procedure and time
- (2) Sufficient tissue area
- (3) Good flexibility and toughness in flap design
- (4) Adequate length of the vascular pedicle of the flap
- (5) Concealed location with minimal damage to the donor site ^[6,7].

Perforator flaps are a new type of surgical flap that can be widely promoted, offering numerous advantages over traditional flaps, including smaller vessel diameters and less donor site damage, better cosmetic outcomes in the recipient area, and eliminating the need for secondary flap cosmetic surgery. They have gradually become a hot topic in the field of microsurgery ^[8]. In clinical practice, most scholars prefer the anterolateral thigh perforator (ALTP) flap with minimal variability. Although the perforating vessels of this flap are relatively constant, their origin is not unique and is uncertain. However, the uncertainty of the origin does not affect the application of this perforator flap ^[9].

4.2. Advantages and disadvantages of different perforator flaps for repairing head and facial tissue defects

There is a diverse range of flaps available for head and facial trauma reconstruction, such as the tensor fasciae latae flap and the medial sural artery perforator flap, all of which provide more options for tissue repair in the head and facial regions. Not only that, the deep inferior epigastric artery perforator flap offers a large amount of

tissue, can be harvested multiple times, and is highly malleable. During harvesting, it does not cause damage to the muscle belly or tendon sheath of the rectus abdominis, nor does it harm the relevant motor nerves of the rectus abdominis^[10]. However, its drawback lies in the fact that the vascular structure of the deep inferior epigastric artery perforator flap often exhibits variations, posing a significant risk of injury and presenting challenges in separation. Failure in this process means failure in flap selection^[11]. Compared to the aforementioned flaps, the anterolateral thigh perforator flap (ALTP) adopted in this study demonstrates more pronounced advantages. Xu Chuanda^[12] first reported the anterolateral thigh flap (ALTF) in 1984 and subsequently further developed the ALTP based on clinical applications. Starting from the anatomical structure of the ALTP, his research team conducted in-depth studies, integrating theory with clinical practice, and explored the practical applications of the ALTP in clinical settings. One of the significant technical adjustments required during ALTP harvesting is its application in scalp reconstruction, where maximizing the length of the vascular pedicle is crucial^[13]. In the actual research, the length of the vascular pedicle was maximized by performing intramuscular dissection from one side. Despite reports suggesting that necrosis may occur when dissecting to the anterolateral thigh perforator artery, in our study, by using facial or more proximal vessels as recipient vessels, which provided sufficient blood supply, this study did not encounter flap necrosis due to arterial dysfunction^[14]. In the patients described in this article, through intramuscular vascular dissection techniques, the length of the ALTP vascular pedicle was sufficient, allowing us to have a very low conversion threshold for the recipient vessel area. This enabled the transition from intact, small-sized superficial temporal vessels to more proximal, larger-caliber vascular systems without the use of vascular grafts, thereby avoiding complications associated with vascular graft usage.

5. Conclusion

In summary, ALTP transplantation can serve as an ideal method for repairing soft tissue defects in the head and face. According to the findings of this study, using ALTP for primary repair of small to medium-sized skin defects caused by head and facial trauma or tumors can achieve both functional and aesthetic outcomes. The flaps harvested from this area do not affect the overall aesthetics of the leg and can adequately avoid critical motor structures. The resulting “imperfections” are also acceptable to patients. Therefore, ALTP holds significant clinical value for the promotion and application in repairing soft tissue defects in the head and face.

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Disclosure statement

The authors declare no conflict of interest.

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