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Salvage of Venous Congestion in a Reverse Anterolateral Thigh Flap Using Leech Therapy: A Case Report

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ABSTRACT

Venous congestion remains one of the most serious complications following reverse anterolateral thigh (ALT) flap reconstruction. If left untreated, it may result in irreversible microvascular damage and flap failure. This case demonstrates the effective use of medicinal leech therapy as a non-surgical salvage method for venous congestion in a reverse ALT flap. A 25-year-old man presented with an open proximal tibial fracture and a 9 × 7 cm anterior knee defect following a traffic accident. Reconstruction was performed using a reverse ALT flap. On the fifth postoperative day, the flap showed signs of venous congestion, and leech therapy was initiated with four leeches applied daily to the congested areas for seven days. The flap showed gradual improvement in color, temperature, and perfusion. A transient drop in hemoglobin (8.1 g/dL) required blood transfusion, but no infection or flap necrosis occurred. Leech therapy promotes venous drainage and improves microcirculation through anticoagulant and vasodilatory effects. Despite potential risks of anemia and infection, it remains a safe and practical salvage technique when surgical revision is not feasible. Medicinal leech therapy represents a simple, effective, and accessible option for managing venous congestion after reverse ALT flap reconstruction, particularly in resource-limited settings where advanced monitoring and microsurgical revision are not available.

Keywords: reverse anterolateral thigh flap, venous congestion, leech therapy, flap salvage, reconstructive surgery

INTRODUCTION

Knee trauma with associated soft tissue defects often requires complex surgical reconstruction. One of the main challenges in knee microvascular repair is the lack of reliable recipient vessels in the injured area. In such cases, the reverse anterolateral thigh (ALT) flap provides a valuable alternative for defect closure. Compared to free flap transfer, the reverse ALT flap offers several advantages, including reduced operative time, decreased donor site morbidity, and lower surgical complexity while maintaining reliable donor tissue. The reverse ALT flap is one of the options for knee defect reconstruction; however, its venous outflow relies on small interconnections to bypass functional venous valves. If left untreated, venous congestion may result in flap edema, compromised perfusion, and ultimately flap failure.[1–3]

Venous congestion is considered a surgical emergency, as severe and irreversible microvascular injury may develop within 6–8 hours. To prevent flap failure, appropriate management must be initiated immediately upon recognition. Flap salvage strategies are generally categorized into surgical and non-surgical approaches. Surgical options include hematoma evacuation, pedicle repositioning or unkinking, revision of venous anastomosis in free flaps, and the addition of a secondary venous drainage. However, in certain situations, surgical intervention may not be feasible, or the underlying cause may remain unclear. In such cases, non-surgical approaches may serve as potential alternatives. Among these, leech therapy is considered the gold standard, supported by satisfactory evidence and with reported success rates of over 70%.[4,5]

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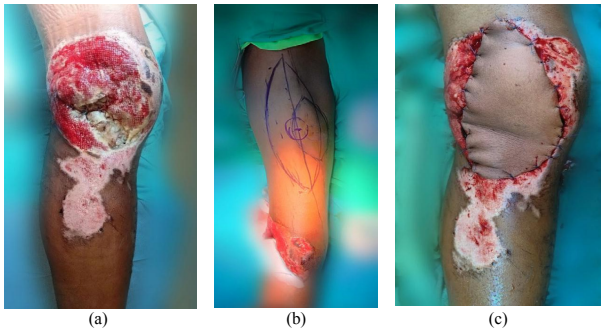
Leeches were approved as a medical device for use in plastic and reconstructive surgery by the FDA in July 2004. Leech therapy is widely recognized as a relatively safe and well-tolerated therapeutic modality. Successful salvage of venous congestion with this approach has been reported in 70–80% of cases.[6,7] However, its application in reverse ALT flap reconstruction has not been widely documented. This case report demonstrates the successful application of leech therapy in managing venous congestion of a reverse ALT flap.

CASE REPORT

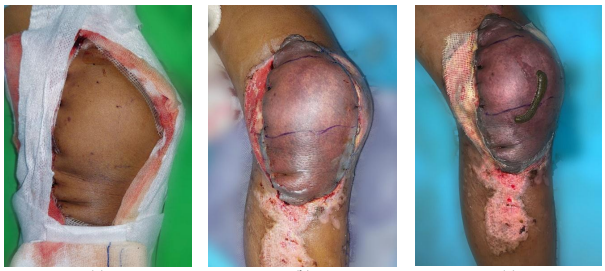
A 25-year-old man was admitted to the Emergency Department of Arifin Achmad Hospital after a traffic accident, presenting with an open fracture of the proximal third of the tibia. Initial management included surgical debridement and stabilization with open reduction and internal fixation (ORIF). Following fixation, a 9 × 7 cm soft tissue defect remained in the anterior knee region, necessitating referral to the Plastic Surgery Department for definitive soft tissue coverage. The wound was managed with honey dressings until the wound bed reached an optimal condition for reconstructive surgery. On the 13th postoperative day after ORIF, reconstruction was performed using a reverse ALT flap (Figure 1). The flap, elevated on a perforator of the descending branch of the lateral femoral circumflex artery (LFCA), was transposed to the knee defect through a created subcutaneous tunnel, and the donor site was closed primarily.



(a) (b) (c)

Figure 1. Reverse ALT flap for coverage of a knee defect. (a) Preoperative appearance showing a 9 × 7 cm soft tissue defect in the anterior knee region following ORIF. (b) Reverse ALT flap design. (c) Postoperative view demonstrating flap placement.

The patient was transferred to the Intensive Care Unit (ICU) following reverse ALT flap surgery. Flap viability was examined hourly during the initial 48 hours, followed by evaluations every 2 hours for the next 12 hours. After 3 days of intensive care, the patient was transferred to the general ward, where flap assessments were performed every four hours. On the fifth postoperative day, the flap demonstrated signs of venous congestion, characterized by dusky discoloration, brisk capillary refill, warmth on palpation, and rapid dark bleeding on pinprick testing (Figure 2). Initial management involved releasing several sutures. However, 4 hours after suture removal, the flap continued to show signs of impaired venous flow. At this point, leech therapy was initiated.



(a) (b) (c)

Figure 2. Venous congestion following reverse ALT flap surgery. (a) Flap on the first postoperative day. (b) Flap on the fifth postoperative day showing dusky discoloration. (c) Application of leech therapy.

During leech therapy, the leeches became engorged after attachment and blood sucking, after which venous congestion subsided, and the flap was preserved (Figure 3). The mean duration of leech attachment to the flap was 5–6 hours (Table 1).

Table 1. Duration of leech attachment in flap salvage.

Day of leech therapy	Leech 1 (minutes)	Leech 2 (minutes)	Leech 3 (minutes)	Leech 4 (minutes)
1st Day	321	310	295	313
2nd Day	342	310	300	316
3rd Day	x295	330	303	340
4th Day	331	344	293	324
5th Day	335	291	348	331
6th Day	345	338	331	298
7th Day	341	332	293	321
The average duration of leech attachment was 320 minutes (≈ 5 hours 20 minutes)				

The patient had no contraindications to leech therapy. Consequently, leech therapy was initiated by applying four leeches to the most congested peripheral areas of the flap once daily. The leeches attached to the flap skin, and each session was continued until spontaneous detachment occurred. After seven days, progressive clinical improvement was observed: the dusky discoloration of the flap diminished, capillary refill returned to normal limits, flap temperature decreased, and the pinprick test revealed an absence of rapid dark bleeding. Based on these findings, leech therapy was discontinued on the seventh day.

Figure 3. Evolution of flap condition. (a) Venous congestion prior to treatment. (b) The first day after discontinuation of leech therapy. (c) Clinical appearance of the flap at the plastic surgery outpatient clinic on postoperative day 15.

On the third day of leech therapy, the patient's hemoglobin level decreased to 8.1 g/dL, prompting transfusion of two units of packed red cells. Re-evaluation on the sixth day demonstrated an increase to 8.9 g/dL. Throughout hospitalization, the patient received intravenous ceftriaxone (1 g every 12 hours) and gentamicin (80 mg every 12 hours), initiated on the first day of admission. A progressive decline in leukocyte count was noted during the course of leech therapy, as summarized in Table 2. The flap was monitored until discharge, with follow-up at the plastic surgery outpatient clinic on postoperative day 15 (four days after discontinuation of leech therapy).

Table 2. Laboratory findings during leech therapy

Time	Hemoglobin (g/dL)	Leukocyte (/µL)
Last test before initiation of therapy	11,1	11.100
3rd day of leech therapy	8,1	11.830
6th day of leech therapy	8,9	7.020
1st day after discontinuation of therapy	11,1	8.870

Normal range: Hemoglobin 14–18 g/dL; Leukocyte 4.800–10.800/µL.

DISCUSSION

Reconstruction of soft tissue defects around the knee remains a challenge in restoring optimal joint function. Surgical planning should aim for the most straightforward method that achieves durable coverage while minimizing donor-site morbidity. Although free flaps are an option, their use is often difficult because recipient vessels in this region are located deep and posteriorly. Since its first description by Zhang et al. in 1990, the reverse anterolateral thigh (ALT) flap has been recognized as a reliable solution for knee region reconstruction. It provides a large cutaneous paddle with a long vascular pedicle, allows extensive mobility for defect coverage, and is associated with low donor-site morbidity. Its vascular basis relies on the anastomosis between the descending branch of the lateral femoral circumflex artery (LFCA) and the lateral superior genicular artery (LSGA), located 3–10 cm above the lateral border of the patella. This connection ensures stable retrograde blood flow and reliable flap perfusion. Several studies have reported successful outcomes using the reverse ALT flap for knee reconstruction.[3,8–10]

Regardless of its advantages, the reverse ALT flap remains inherently predisposed to venous congestion due to retrograde blood flow and venous valve resistance, which can ultimately compromise flap survival. The etiology is often multifactorial and can be classified into intrinsic factors, such as arterial spasm or mechanical obstruction of the vascular pedicle, which may occur when longer pedicles are tunneled beneath soft tissue, and extrinsic factors, including hematoma, tight dressings, or excessive skin closure[11–14]

Because these mechanisms are difficult to distinguish postoperatively, timely detection and intervention are crucial, particularly as most cases of vascular thrombosis occur within the first 48–72 hours, and irreversible microvascular injury may develop within 6–8 hours if left untreated. Wang et al. (2020) recommend hourly flap monitoring during the initial 48 hours, followed by progressively lengthened intervals.[4,11,15] While advanced technologies such as hand-held doppler, near-infrared angiography, or digital photography can facilitate assessment, they are not universally available. In such settings, clinical evaluation continues to serve as the most reliable method of monitoring perfusion. Key parameters include flap color, capillary refill, tissue turgor, temperature, and pinprick bleeding, which also allow differentiation between arterial insufficiency and venous congestion. In our case, venous congestion was identified early based on these clinical signs, which guided the decision for immediate salvage intervention.[11,12,16]

Among postoperative vascular complications, venous insufficiency occurs more frequently than arterial occlusion and represents the leading cause of flap failure. Once venous congestion is identified, immediate intervention is essential, as prolonged compromise can rapidly progress to irreversible microvascular injury. Initial management may involve simple measures such as loosening an overly tight dressing, removing a splint or compressive garment, or releasing sutures that contribute to a tourniquet effect on the flap. For cases requiring further intervention, flap salvage can be achieved through either surgical or non-surgical procedures. Surgical options include evacuation of hematoma, correction of pedicle kinking, revision of venous anastomosis in free flaps, or addition of a second drainage vein. However, surgical procedures are not always feasible, particularly when the underlying cause cannot be identified. In such situations, non-surgical strategies can be considered, including subcutaneous heparin injection, negative pressure therapy, hyperbaric oxygen therapy, and medicinal leech therapy. Among these, leech therapy represents a simple and practical alternative for relieving venous congestion, particularly in settings where immediate surgical revision is not feasible.[4,17]

Leech therapy is a well-recognized option for flap salvage, with reported success rates of up to 85% in the literature. It is specifically indicated for the management of venous congestion. The most commonly used species is *Hirudo medicinalis*, although other species, such as *Hirudo verbana* and *Hirudo michaelseni*, have demonstrated similar therapeutic outcomes. The therapeutic effect of leech therapy is mediated through three primary mechanisms: active blood removal, passive bleeding from the bite site, and the secretion of biologically active compounds present in leech saliva. *Hirudo medicinalis* saliva contains over 100 bioactive compounds, including vasodilators, anticoagulants, platelet aggregation inhibitors, anesthetic agents, and antibacterial as well as anti-inflammatory molecules. Although several contraindications exist such as patient refusal, severe anemia, or immunosuppression-leech therapy is generally regarded as a safe, simple, and practical alternative for managing venous congestion in external flaps.[6,11,18,19]

Leech therapy can be performed using a variety of techniques. Leeches should be applied to areas of clinically significant congestion, typically identified by a dusky or cyanotic appearance of the tissue. They attach to the host using a large caudal sucker and create a Y-shaped bite with the smaller cephalic sucker, secreting anesthetic compounds, resulting in the bite being effectively painless. The number of leeches applied varies according to the area and size of the affected tissue, typically ranging from 1 to 5 per session, or approximately 1 leech per 3 cm^2 of congested tissue. After feeding, leeches swell and detach spontaneously, with the duration of attachment varying across applications. Clinical improvement in tissue perfusion was observed on average 1.1 days after application. Leech therapy is generally continued for 6–10 days, until flap neovascularization is evident, with the duration guided by clinical assessment, including flap color, capillary refill, and bleeding on pinprick testing.[6,20–22]

At our hospital, formal protocols regarding species selection, leech number, therapy duration, and documentation have not yet been established.

Most studies report no significant adverse effects associated with leech therapy. The most commonly observed complications are anemia and infection, while additional complications may include local irritation, peripheral edema, transient confusion, and a drop in systolic blood pressure

(15–20 mmHg). According to Whitaker et al. (2012), 50% of patients receiving leech therapy required blood transfusions. Hemoglobin levels should be carefully monitored, as transfusion is frequently necessary for patients undergoing leech therapy. Ideally, a complete blood count should be obtained prior to initiating therapy. During therapy, hemoglobin should be assessed daily or every other day, depending on the number of leeches applied. Blood transfusion is indicated when hemoglobin falls below 8 g/dL or in the presence of poor clinical tolerance. Typically, the estimated blood loss from a single leech applied every two hours is about 1 g/dL per day. Transfusion is generally required when leech therapy extends beyond five days and/or if the patient's baseline hemoglobin is below 12 g/dL.[3,18,20,23–26]

Infections associated with leech therapy are occasionally caused by symbiotic bacteria residing in the leech's digestive tract. The most frequently implicated species is *Aeromonas hydrophila*, which may result in localized or systemic infections. These infections can develop within 24 hours of leech application or up to one month thereafter. According to Whitaker et al. (2012), 14% of patients developed infections following leech therapy.[26] Clinical manifestations include lymphangitis, dermohyperdermitis, abscess formation, severe sepsis, and gas-forming necrotizing myositis. Infections significantly reduce flap salvage rates, decreasing success from 88% to 37%. The most effective antibiotics against Aeromonas species include third-generation cephalosporins, aminoglycosides, tetracyclines, trimethoprim-sulfamethoxazole, and fluoroquinolones. These agents are also considered first-line options for prophylactic management of infection during leech therapy[6,20,23,27]

CONCLUSSION

Early detection and timely intervention are crucial to achieving successful flap salvage in cases of venous congestion following reverse anterolateral thigh (ALT) flap reconstruction. This case demonstrates that medicinal leech therapy can be a reliable, effective, and accessible option when surgical revision is not immediately feasible. Clinically, this case highlights the importance of careful postoperative monitoring and rapid decision-making based on clinical assessment, especially in settings where advanced monitoring technologies are unavailable. Integrating leech therapy into postoperative care, supported by appropriate monitoring and infection control, can enhance flap survival and overall patient recovery. Finally, standardized application and monitoring protocols for leech therapy can help ensure both safety and reliability in flap salvage procedures.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest regarding the publication of this paper.

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