



A Classic and Effective Approach for Managing Totally Implantable Venous-Access Port Site Dehiscence in Patients with Cancer: The Limberg Flap

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Abstract

Background: Totally implantable venous-access ports (TIVAPs) are essential for long-term intravenous treatment in cancer patients, but TIVAP site dehiscence remains a significant issue. This study aims to investigate how Limberg flap transposition compares to primary repair and other local flap techniques in managing TIVAP site dehiscence.

Methods: A retrospective study was conducted on patients who underwent repair operations, without TIVAP removal, for right subclavicular area TIVAP site dehiscence between May 2016 and March 2023. Outcomes of primary repair, Limberg flap transposition and other local flap surgeries were analyzed, focusing on incisional integrity and dehiscence recurrence rate.

Results: Nine patients and 3,204 catheter days were included in the study, with a total of 15 surgical repair procedures performed for dehiscence, including cases of recurrence. Among them, Limberg flap transposition demonstrated the longest period of incisional integrity, with a mean of 231.4 days, surpassing primary repair (74.25 days) and other local flap techniques (29.5 days). Additionally, the Limberg flap exhibited the lowest recurrence rate, with 0.86 events per 1,000 catheter days, compared to primary repair (10.10 events per 1,000 catheter days) and other local flap approaches (16.95 events per 1,000 catheter days).

Conclusion: Limberg flap transposition is considered as an effective solution for TIVAP site dehiscence, showing reduced complications and recurrence rates compared to primary repair and other local flap techniques. This study suggests Limberg flap transposition should be considered the preferred option for managing TIVAP dehiscence in cancer patients, thereby improving patient care and outcomes.

Keywords: Surgery, plastic; Surgical wound dehiscence; Surgical flaps

Introduction

Totally implantable venous-access ports (TIVAPs) are essential for long-term intravenous treatment in cancer patients [1]. These small, self-sealing devices are implanted under the skin and connected to a central vein, allowing easy, repetitive access to the bloodstream. This ease of access is crucial not only for the administration of chemotherapy but also for other medical treatments requiring intermittent intravenous medication. While implanted ports were first reported in 1982, their surgical implantation continues to be associated with various complications [2], including hematoma, seroma, and problematic wound healing. Wound dehiscence, the rate of which ranges from 1% to 3% [3,4], poses one of the most significant challenges, and occurs more commonly in patients receiving cytotoxic agents or vascular endothelial growth factor inhibitors [5,6]. Superficial placement of the port by interventional radiologists is also known to result in frequent dehiscence and externalization [3].

The recurrent nature of dehiscence not only disrupts cancer treatment but can ne-

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cessitate frequent interventions or even lead to the premature removal of the device. Current management strategies for TIVAP site dehiscence lack standardization, highlighting the need for more effective and consistent treatment approaches.

To mitigate the risk of recurrent dehiscence, we propose using a well-established surgical technique, the Limberg flap, as a reliable solution for TIVAP site dehiscence while maintaining port functionality. Originally described by Alexander Limberg in 1948, the Limberg flap involves transposing a flap to cover a rhomboid-shaped defect. This flap exhibits two sides of equal length and medial and lateral angles of 120° on opposing ends and superior and inferior angles of 60° [7,8]. The design of the Limberg flap allows wound closure with less tension between the rhomboid-shaped defect and the donor site [9].

In this article, we detail our surgical technique, review our clinical outcomes, and evaluate the effectiveness of the Limberg flap for managing TIVAP site dehiscence. By consolidating our findings with existing literature, we aim to solidify the Limberg flap's role as a viable and superior option for addressing this prevalent complication.

Methods

Patients

A retrospective chart review was conducted of patients who underwent re-operation for dehiscence after TIVAP insertion at a single institution from May 2016 to March 2023. The study underwent review and approval by the Institutional Review Board of Severance Hospital (IRB No. 2023-3087-002). Each patient provided proper informed consent and received an explanation of the procedure. This research was conducted in accordance with the Helsinki Declaration.

The TIVAPs used in these cases were Bard PowerPort isp M.R.I. Implantable Ports (Becton, Dickinson & Co.), with dimensions measuring 29 mm in diameter and 11.6 mm in height. The inclusion criteria were as follows: (1) patients of all ages and both sexes; (2) patients diagnosed with malignancy who required chemotherapy administered through a TIVAP; (3) patients with TIVAP site wound dehiscence; and (4) patients who underwent repair surgery without removal of the TIVAP. The exclusion criteria included: (1) patients who received radiotherapy at or near the TIVAP site; and (2) patients with limited postoperative follow-up.

TIVAP site dehiscence was defined as the exposure of the device, thinning of the skin overlying the device or instability of the wound limiting port access. Participants were followed

until chemotherapy treatment was completed and the TIVAP was removed, ongoing issues necessitated the removal of the TIVAP, or until the patient's death.

Data collected included demographics, cancer type, and chemotherapy agents (cytotoxic, targeted agents). We analyzed postoperative outcomes such as wound integrity duration, dehiscence recurrence rate, and complication rates to compare the efficacy of Limberg flap transposition against other surgical methods. Specifically, we assessed how the Limberg flap group performed in comparison to patients treated with primary repair or other local flap operations, in order to determine which method offered superior management of dehiscence. The duration of TIVAP use post-repair was quantified as "catheter days," and the dehiscence rate per 1,000 catheter days was calculated by dividing the number of dehiscence events by the number of catheter days and multiplying by 1,000.

To accurately assess the efficacy of repair surgeries for TIVAP site dehiscence, this study employed "wound integrity duration" and "dehiscence recurrence rate" as primary outcome measures. These metrics are critical as they directly reflect the surgical success in terms of wound closure stability and the long-term effectiveness of the intervention. Specifically, wound integrity duration, referred to in our results as maintenance period, measures how long the surgical site remains intact without signs of reopening. Meanwhile, dehiscence recurrence rate is crucial for evaluating the long-term resilience of the repair and the overall quality of patient care. Using these specific outcomes ensured that our study provides meaningful data on the effectiveness of different surgical techniques.

For most variables, the mean values of the primary repair group and the Limberg flap group were compared using the Mann-Whitney U test, appropriate for the study's small sample size. Statistical significance was established at P-values <0.05. All analyses were performed using SPSS version 28.0 (IBM Corp.), ensuring rigorous statistical evaluation.

Surgical technique

The authors decided to apply the Limberg flap for TIVAP site dehiscence for the following reasons: First, the Limberg flap, despite being a local flap, uniquely allows for placement of its thickest central part directly in the middle of the defect, unlike other local flaps. Second, as the anterior chest, being part of the trunk, has more abundant blood flow compared to the extremities, random pattern flaps such as the Limberg flap can also be expected to maintain good vascular circulation around the dehiscence site. Third, the tissue laxity around the chest

TIVAP site permits thorough debridement while still allowing for the harvest of an appropriately sized flap. This tissue laxity enables surgeons to choose from all types of local flaps, and significantly allows for considering more extensive procedures such as transposition or rotational flaps.

The Limberg flap technique involves elevating a flap with side lengths of 2.9–3.2 cm from the lateral or cephalic side of the TIVAP site. Flaps are elevated at the deep fascial plane to ensure full-thickness inclusion of the subcutaneous layer. Capsulectomy of the tissue surrounding the TIVAP is then performed, followed by basal debridement to ensure deeper placement. Wound closure is completed with Vicryl #3-0 and nylon #3-0 sutures. No drains are inserted. After surgery, simple dressings using ointment are applied to the wound, and the stitches are removed 2 weeks later (Fig. 1).

Results

A total of nine patients from three different operators were included, with the initial placement of the TIVAP in all patients being subcutaneous and located in the right sub-clavicular area. Each patient underwent either primary repair, Limberg flap transposition, or other local flap operations. Six of the patients were female (67%). Six patients required re-operation for recurrent dehiscence (67%). Only one patient received targeted chemotherapy (11%). The age of the patients at the initial surgery for TIVAP placement ranged from 16 to 80 years. No two patients had the same type of malignancy with every patient having a unique type (Table 1).

In this study, the progression of TIVAP site dehiscence followed a general pattern, beginning with thinning of the skin



Fig. 1. Surgical technique of Limberg flap transposition. (A) Intraoperative flap design: donor site is selected lateral or cephalic to the totally implantable venous-access port (TIVAP). (B) Intraoperative photograph: additional debridement of the basal section of the TIVAP insertion pocket to facilitate provision of a thick flap with minimal tension on the incisions. (C) Immediate postoperative image. (D) Postoperative day 2 of Limberg flap transposition.

overlying the TIVAP. As the condition progressed, discharge was noted from the previously sutured and ostensibly healed incision line. This discharge eventually hardened, forming a crust over the wound. Routine wound cleansing or natural detachment of the crust frequently led to the exposure of the underlying device. These findings were consistent across cases where initial interventions had failed, necessitating further surgical management.

Eight primary repairs were performed, with three of them being reoperations. Five Limberg flap transpositions were performed, with two of these being reoperations for recurrent de-

hiscence. Two local flap operations were performed including one keystone flap for primary dehiscence and one advancement flap for recurrent dehiscence.

The Limberg flap demonstrated the longest incisional integrity period (231.4 days), surpassing primary repair (74.3 days) and other local flap techniques (29.5 days) (Table 2). The probability of dehiscence recurrence was lowest in the Limberg flap group (20%), followed by other local flap operations (50%) and primary repairs (75%). The Limberg flap group showed the lowest dehiscence recurrence rate, considering the maintenance of incision integrity period, as 0.86 events per 1,000

Table 1. Patient demographics

Patient No.	Sex	Age (yr)	BMI (kg/m ²)	Cancer type	Chemo agent	Maintenance period (day) (original insertion) ^{a)}	Repair modality	Maintenance period (day) (repair) ^{b)}	Dehiscence recurrence
1	F	38	18.87	Ovarian cancer	Cytotoxic	60	Primary repair (1st) Primary repair (2nd)	75 23	+ –
2	F	45	21.30	Malignant peripheral nerve sheath tumor	Targeted	910	Keystone flap (1st) Limberg flap (2nd)	26 90	+ –
3	F	64	30.62	Heart sarcoma	Cytotoxic	11	Primary repair (1st) Limberg flap (2nd)	71 409	+ –
4	F	63	24.85	Calf sarcoma	Cytotoxic	63	Limberg flap (1st) Primary repair (2nd)	19 34	+ +
5	M	17	21.89	Osteosarcoma	Cytotoxic	47	Limberg flap	349	–
6	F	68	20.28	Pancreatic head cancer	Cytotoxic	58	Limberg flap	290	–
7	M	16	21.30	Burkitt lymphoma	Cytotoxic	140	Primary repair	223	–
8	F	80	28.99	Vulvar malignant melanoma	Cytotoxic	42	Primary repair (1st) Primary repair (2nd)	14 130	+ +
9	M	67	27.04	Prostate cancer	Cytotoxic	63	Primary repair (1st) Advancement flap (2nd)	24 33	+ –

BMI, body mass index.

^{a)}The maintenance period of original insertion refers to the duration between the day when the device was initially inserted and the first occurrence of wound dehiscence; ^{b)}The maintenance period after repair is defined as the duration from the day of the repair procedure until either dehiscence recurred (in cases where dehiscence reoccurred), or until follow-up was finished (in cases where dehiscence did not recur).

Table 2. Repair outcomes

Repair modality	Operation count	Average maintained period (95% CI) (day)	Dehiscence recurrence probability (95% CI) (%)	Dehiscence recurrence rate (95% CI) (/1,000 catheter days)
Limberg flap transposition	5	231.4 (35.2–427.6)	20.0 (17.7–48.3)	0.86 (0–5.4)
Primary repair	8	74.3 (16.5–132.0)	75.0 (55.1–78.7)	10.1 (4.1–22.3)
Other local flap ^{a)}	2	29.5	50.0	17.0
P-value ^{b)}		0.107	0.026	<0.002

CI, confidence interval.

^{a)}In the other local flap group, the confidence interval was not calculated due to the small sample size of 2; ^{b)}P-value was determined by Mann-Whitney U test. P<0.05 denotes statistical significance.

catheter days. The primary repair group and other local flap groups showed 10.10 and 16.95 events per 1,000 catheter days. The Limberg flap group demonstrated statistically significant lower dehiscence recurrence rates and probabilities.

All Limberg flaps survived without any evidence of necrosis, seroma, hematoma, or newly developed postoperative infection. One patient was found to have a *Pseudomonas* infection in the placement site of the TIVAP at both the initial place-

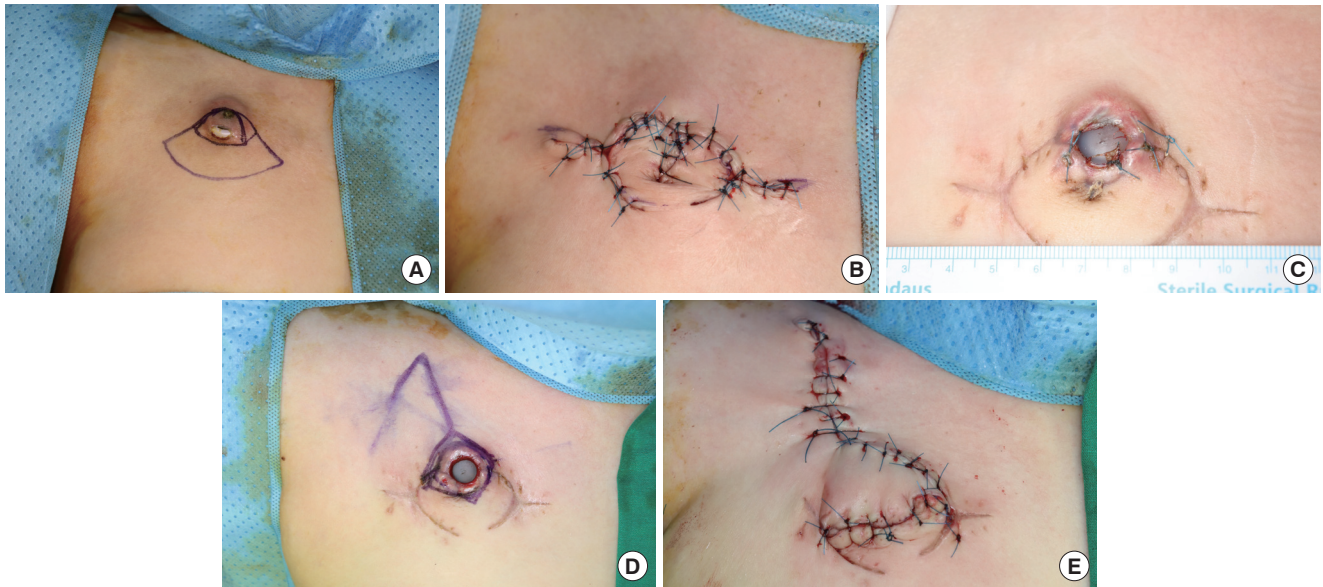


Fig. 2. Limberg flap repair after failure of keystone flap. (A) Keystone flap design in a patient with a malignant peripheral nerve sheath tumor. Initial keystone flap design of first dehiscence repair is shown. (B) Immediate postoperative photograph of the keystone flap. (C) Recurrence of wound dehiscence on postoperative day 26. (D) Re-operation design for the Limberg flap. The flap was harvested from the cephalic side of the chemoport, with a side length of 2.9 cm. (E) Immediate postoperative image.

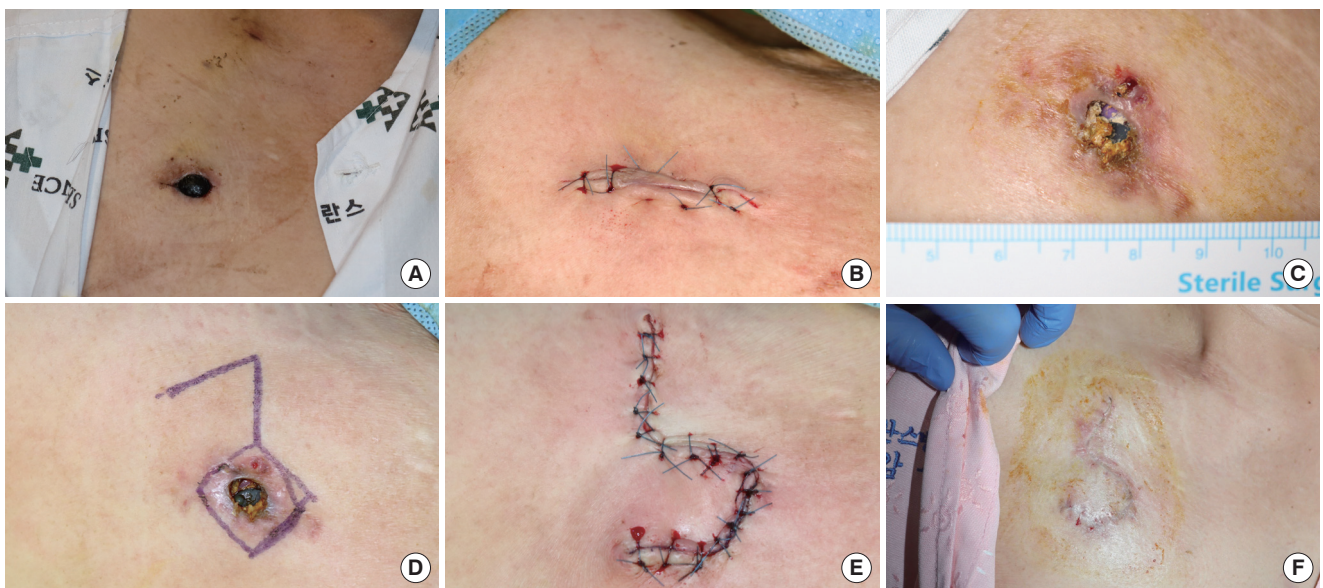


Fig. 3. Limberg flap repair after failure of primary repair. (A) Wound dehiscence secondary to wound hematoma. (B) Immediate postoperative photograph after initial debridement of the hematoma and surrounding necrotic tissue treated followed by primary repair. (C) Recurrence of wound dehiscence after 71 days. (D) Limberg flap design harvested from the cephalic side, with a side length of 3.1 cm. (E) Immediate postoperative image. (F) Postoperative day 20 of the Limberg flap procedure.

ment procedure as well as at the initial re-operation for dehiscence. She developed recurrent dehiscence at the donor site with the flap over the port remaining intact which allowed her to continue its use. She eventually had the TIVAP removed after a third dehiscence due to this intractable infection.

Case 1

A 45-year-old female patient (patient number 2) with malignant peripheral nerve sheath tumor presented with a TIVAP site dehiscence. Initially, we performed keystone flap advancement which resulted in recurrent dehiscence 26 days after the initial flap surgery. A second re-operation was performed using a Limberg flap harvested from the cephalic side with a side length of 2.9 cm. The patient continued to use this chemoport until she succumbed to cancer progression (Fig. 2).

Case 2

A 64-year-old female patient (patient number 3) was diagnosed with heart sarcoma and underwent TIVAP insertion, which remained intact for only 11 days. Dehiscence accompanied by hematoma was observed. Debridement and primary repair were initially performed. However, after 64 days, recurrent dehiscence occurred. A Limberg flap, harvested from the cephalic side of the TIVAP with a side length of 3.1 cm, was used for reconstruction. At our last chart review, she was still using the TIVAP with no complications (Fig. 3).

Discussion

The Limberg flap, a well-established surgical technique introduced by Alexander Limberg in 1948 [7,8], has become a



Fig. 4. Progression of Limberg flap repair in chemoport site dehiscence. (A) Wound dehiscence. (B) Preoperative Limberg flap design with the donor site selected from the lateral side of the totally implantable venous-access port. (C) Immediate postoperative image of the Limberg flap. (D) Postoperative day 15 of the Limberg flap after all sutures were removed.

mainstream surgical option for various conditions causing sizeable soft tissue defects such as pilonidal sinus disease as well for surgical wound dehiscence [9,10]. Its straightforward design and excellent outcomes have contributed to its widespread surgical acceptance [11]. Notable advantages of the Limberg flap include minimal donor site morbidity and a short learning curve. In the context of anterior chest wall TIVAP site dehiscence, the ability to directly harvest nearby soft tissue in creation of the flap results in favorable esthetic outcomes in terms of texture and color (Fig. 4). In addition, the use of imaging equipment such as Doppler for confirmation of blood supply or computed tomography scans is often unnecessary.

In this study, the duration of operative times for the Limberg flap technique was longer than that of primary repair; however, the Limberg flap resulted in superior results. The authors infer that the superior outcomes of the Limberg flap can be attributed to its ability to position the thickest part of the flap centrally within the wound, the relatively robust blood flow in the trunk compared to the extremities, and the excellent tissue laxity of the surrounding upper chest area, as previously described. Additionally, the suture lines of the Limberg flap were strategically placed away from the TIVAP, minimizing tension and enhancing overall stability. Moreover, while local advancement flaps often utilize skin that may be thinned and inflamed due to proximity to the dehiscence site, the Limberg flap, as a transposition flap, allows for the harvesting of skin from more distant, healthier areas. This approach provides fresher and thicker skin coverage, which is less likely to succumb to further dehiscence, thereby offering a more durable solution for covering exposed devices. These factors together underscore the Limberg flap's effectiveness in managing TIVAP site dehiscence, supporting its use over more conventional local advancement techniques.

The Limberg flap group also exhibited the shortest time to resumption of chemotherapy administration, whether by the TIVAP or via peripheral access, although quantitative comparisons were not explicitly stated in the results due to variations in chemotherapy regimens and schedules. This observation suggests a potential benefit to the administration of chemotherapy by avoiding additional delays.

When seeking venous access via the TIVAP, clinicians must rely on their palpation skills to identify the proper site. Covering the TIVAP with a thick subcutaneous layer using the Limberg flap technique can make puncturing the TIVAP more challenging than with more superficial placement. However, the Limberg flap results in a distinctive surgical scar resem-

bling the Big Dipper constellation with the TIVAP being positioned in its handle which facilitates its identification.

The limitations of this study include the small number of cases, which may limit the generalizability of the findings despite achieving statistical significance, and also its retrospective design and the fact that only data from a single institution was included. Future research should aim to address these limitations by expanding the sample size with additional institutions and increasing the duration of the study to achieve statistical significance. In addition, the results may have been influenced by the outcomes of three different surgeons and the potential impact of a variable learning curve. Since the Limberg flap method relies on having substantial subcutaneous fat layer thickness, investigating the influence of a low or very low body mass index on success rates also remains a goal for future investigation.

In conclusion, Limberg flap transposition represents a classic but effective solution for TIVAP site dehiscence, offering broad applicability with less complications and low recurrence rates. We propose that the Limberg flap technique should be considered as the preferred option for managing TIVAP site dehiscence in cancer patients, thereby promoting improved outcomes with fewer delays of treatment resulting in an enhanced quality of care.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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