

CLINICAL OUTCOMES OF USING PEDICLED LATISSIMUS DORSI MUSCLE FLAPS IN THE TREATMENT OF LARGE CHEST WALL DEFECTS

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Abstract

Objectives: To evaluate the efficacy and safety of the pedicled latissimus dorsi (LD) muscle flaps for the reconstruction of large chest wall defects. **Methods:** A retrospective and prospective, descriptive, interventional study was conducted on 30 patients with large chest wall defects treated with pedicled LD muscle flaps at Le Huu Trac National Burn Hospital and 108 Military Central Hospital from September 2020 to November 2025. **Results:** The cohort comprised 30 patients (7 males, 23 females) with a mean age of 55.83 ± 15.18 years. The primary etiologies were radiation-induced sequelae (70.0%) and burns (26.7%). The latissimus dorsi muscle flaps were harvested with mean dimensions of 19.57 ± 4.29 cm in length and 10.7 ± 2.82 cm in width. Overall flap survival was 96.67% (29/30 flaps); partial necrosis occurred in one case (3.33%). Skin grafts healed successfully on the muscle flap, and primary closure of the donor site was achieved in 100% of cases. At the 6-month follow-up (n = 28), 100% of patients demonstrated preserved shoulder function, favorable scar aesthetics, and high satisfaction with both functional and aesthetic outcomes. **Conclusion:** The pedicled LD muscle-only flap is a safe and highly effective modality for reconstructing large chest wall defects, providing durable coverage with a 96.67% success rate and ensuring full preservation of shoulder range of motion.

Keywords: Latissimus dorsi muscle flap; Large chest wall defects; Endoscopic harvest; Radiation-induced sequelae.

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INTRODUCTION

Reconstruction of large chest wall defects remains a significant challenge in plastic and thoracic surgical practice [1, 2]. The etiology of these defects is diverse, encompassing oncological resection (e.g., breast cancer, soft tissue sarcomas), severe trauma, deep thermal burns, and infectious or radiation-induced sequelae.

Among these etiologies, chronic radiation-induced ulcers represent a complex clinical entity [3]. The pathophysiology of such lesions involves a "vicious cycle" of progressive obliterative endarteritis, tissue fibrosis, hypoperfusion, and aseptic necrosis. This state of chronic ischemia renders conservative management and simple coverage techniques, such as split-thickness skin grafting, almost invariably futile. Similarly, local random flaps are often unfeasible or contraindicated as the adjacent tissue typically lies within the compromised radiation field. The "gold standard" principle for managing these defects mandates the radical debridement of all necrotic and fibrotic tissue down to a healthy, well-perfused base, followed by immediate reconstruction using a flap with an independent, reliable blood supply.

The LD flap is widely regarded as the classic "workhorse" for chest wall reconstruction [1, 2]. First described by Tansini in 1896 and standardized by Olivari (1976) and Bostwick (1979),

the LD flap offers distinct advantages, including a large surface area, a consistent thoracodorsal neurovascular pedicle, a wide arc of rotation, and high reliability [4, 5].

In Vietnam, studies by Le Van Doan (2003) and Nguyen Roan Tuat (2011) have corroborated the role and clinical efficacy of this flap [6, 7]. However, international literature suggests that the use of conventional myocutaneous flaps can result in significant donor site morbidity [2]. A viable alternative is the utilization of a muscle-only flap combined with skin grafting. Furthermore, the advent of endoscopic surgery, pioneered by Ramakrishnan in 1997, provides a minimally invasive option to minimize scarring and improve donor site aesthetics [8].

Therefore, this study was conducted with objectives: *To evaluate the efficacy and safety of the pedicled LD muscle flap for the reconstruction of large chest wall defects.*

MATERIALS AND METHODS

1. Subjects

The study included 30 patients presenting with large chest wall defects treated with pedicled LD muscle-only flaps. Among these, 15 patients underwent endoscopically-assisted harvesting of the LD muscle flap, while the conventional open approach was utilized for the 15 cases.

** Inclusion criteria:* Patients diagnosed with large chest wall defects requiring reconstructive surgery; those with specific indications for and treated with pedicled LD muscle-only flaps; patients treated at the designated study sites (Le Huu Trac National Burn Hospital or 108 Military Central Hospital) during the study period; patients with complete medical records and clinical data required for the study.

** Exclusion criteria:* Chest wall defects that were small and could be closed by simpler methods (e.g., primary closure or skin grafts); patients with contraindications for the use of LD flaps (e.g., previous injury to the thoracodorsal nerve or vessels); those who underwent reconstruction using myocutaneous flaps (LD flaps with a skin paddle) instead of muscle-only flaps; Incomplete medical records or patients who were lost to follow-up before the study outcomes could be evaluated.

** Time and study settings:* From September 2020 to November 2025 at Le Huu Trac National Burn Hospital and 108 Military Central Hospital.

2. Methods

** Study design:* A retrospective and prospective, descriptive, interventional study.

** Surgical procedure:*

Defect management: Patients were placed in the supine position. Radical debridement of the ulcer, sclerotic tissue, and inflammatory induration was

performed down to a healthy, pliable tissue bed, ensuring punctate bleeding was visualized.

Flap harvest: Patients were repositioned to the prone or lateral decubitus position. In 100% of cases, the LD was harvested as a muscle-only flap.

Conventional open technique (n = 15): A longitudinal incision was made along the anterior border of the LD muscle. The skin was elevated from the muscle, and the entire muscle belly was dissected and mobilized, preserving the thoracodorsal neurovascular pedicle.

Endoscopic technique (n = 15): A short incision (approximately 4 - 7cm) was made. Two to three trocar ports were utilized to dissect, mobilize, and release the LD muscle flap under video-assisted endoscopic visualization.

Flap transfer and coverage: A subcutaneous tunnel was created in the axillary region. The muscle flap was transposed anteriorly (with the patient returned to the supine position) to cover the defect, and the muscle was sutured to the margins of the defect. Closed suction drains were placed beneath the flap.

Donor site management: Given the use of a muscle-only flap, 100% of donor sites were closed primarily in two layers. Suction drains were placed.

Skin grafting: Thin split-thickness skin grafts (0.2 - 0.3mm) were harvested from the thigh using a Zimmer dermatome.

The grafts were meshed and secured to cover the entire muscle surface.

Outcome measures:

Primary outcomes: Flap viability (complete survival, partial necrosis, total necrosis); skin graft take rate; donor and graft site healing status; healing time; and complications.

Secondary outcomes: Aesthetic and functional evaluation (Good/Fair/Poor) of the recipient, donor, and graft harvest sites; shoulder range of motion; and patient-reported satisfaction.

* *Statistical analysis:* Data analysis was performed using SPSS software, version 25.0. Continuous variables were compared

using the Student's T-test. A p-value of < 0.05 was considered statistically significant.

3. Ethics

This article is a scientific product of research project No. CT08/11-2022-3 under Decision No. 2633/QĐ-UBND of the Hanoi People's Committee. The study was approved by the Ethics Committee of Vietnam Military Medical University under Certificate No. 15/2023/CNChT-HĐĐĐ. The research data were authorized for use and publication by Le Huu Trac National Burn Hospital and 108 Military Central Hospital. The authors declare that there are no conflicts of interest related to the content of this article.

RESULTS

The study cohort consisted of 30 patients (23 females and 7 males) with a mean age of 55.83 ± 15.18 years. The primary etiologies were radiation-induced sequelae ($n = 21$; 70.0%) and thermal burns ($n = 8$; 26.7%); the remaining case (3.3%) presented with malignant ulceration. Subgroup analysis indicated that the post-radiation group had a significantly higher mean age (61.52 years) compared to the post-burn group (39.63 years).

Table 1. Comparison of defect dimensions pre- and post-debridement ($n = 30$).

Dimension	Pre-debridement	Post-debridement	p
Length (cm)	8.10 ± 3.40	12.60 ± 3.09	< 0.05
Width (cm)	5.37 ± 2.39	8.93 ± 3.13	< 0.05
Area (cm ²)	50.17 ± 41.78	120.57 ± 71.55	< 0.05

The mean defect surface area upon admission was $50.17 \pm 41.78\text{cm}^2$. Following radical debridement of fibrotic and necrotic tissue, the actual defect requiring coverage increased significantly to $120.57 \pm 71.55\text{cm}^2$. The differences in area, length, and width pre-and post-treatment were statistically significant ($p < 0.05$), demonstrating that the true extent of tissue loss typically exceeds the initial clinical estimation.

Table 2. Latissimus dorsi muscle flap dimensions (n = 30).

Parameter	Value ($\bar{X} \pm SD$)	Maximum size (cm)	Minimum size (cm)
Length	19.57 $\pm$ 4.29	29	14
Width	10.70 $\pm$ 2.82	16	5

The LD muscle flaps were harvested with mean dimensions of 19.57 $\pm$ 4.29 cm in length and 10.7 $\pm$ 2.82cm in width.

Table 3. Comparison of incision length and operative time by technique.

Method	Incision length (cm)	Operative time (hours)
Open surgery (n = 15)	18.13 $\pm$ 3.04	2.23 $\pm$ 0.42
Endoscopic surgery (n = 15)	4.73 $\pm$ 0.77	2.73 $\pm$ 0.37
Total (n = 30)	11.43 $\pm$ 7.16	2.48 $\pm$ 0.46

Comparing the two techniques (n = 15 per group), the endoscopic approach resulted in a significantly shorter incision length compared to the open technique (4.73 $\pm$ 0.77cm vs. 18.13 $\pm$ 3.04cm). However, the operative time for the endoscopic group was significantly prolonged compared to the open group (2.73 $\pm$ 0.37 hours vs. 2.23 $\pm$ 0.42 hours); this difference was statistically significant (p < 0.05).

Table 4. Distribution of healing time, drainage, and hospital stay (n = 30).

Parameter	Mean duration (days $\pm$ SD)	Open surgery	Endoscopic surgery
Healing time (Recipient site)	19.07 $\pm$ 11.01	22.2 $\pm$ 14.04	15.93 $\pm$ 3.6
Healing time (Donor site)	14.40 $\pm$ 6.09	14.93 $\pm$ 8.18	13.87 $\pm$ 3.04
Healing time (Graft site)	12.87 $\pm$ 1.99	12.73 $\pm$ 1.53	13 $\pm$ 2.42
Drainage duration	6.97 $\pm$ 2.86	7 $\pm$ 2.77	6.93 $\pm$ 3.04
Hospital stay	31.87 $\pm$ 21.78	33.8 $\pm$ 19.54	30.4 $\pm$ 24.04

The mean healing time at the recipient site was 19.07 $\pm$ 11.01 days, skewed by a single outlier requiring secondary healing (maximum 68 days). The mean donor site healing time was 14.40 $\pm$ 6.09 days. The mean duration of drainage was 6.97 $\pm$ 2.86 days, and the mean length of hospital stay was 31.87 $\pm$ 21.78 days.

Evaluation of early outcomes: The complete flap survival rate was 96.67% (29/30). One case (3.33%) of partial (marginal) necrosis was recorded (Table 4). The skin graft achieved 100% take over the muscle bed. Primary healing and favorable epithelialization were achieved in 100% of cases at both the donor site (on the back) and the skin graft harvest site.

At 3 months (n = 30): "Good" outcomes were recorded in 96.67% (29/30) of recipient sites and 100% of donor and graft harvest sites. One patient (3.33%)

was rated as "Fair/Average" due to wound dehiscence necessitating surgical revision. Favorable scar aesthetics (flat scars) and 100% preservation of shoulder motor function were observed in all patients. Patient satisfaction ranged from 96.67% to 100% across anatomical regions.

At 6 months (n = 28): Of 28 patients followed up at 6 months, 100% were evaluated as "Good" across all three sites (recipient, donor, and graft harvest). Flat scars and normal shoulder range of motion were maintained in all cases. All patients reported high satisfaction.

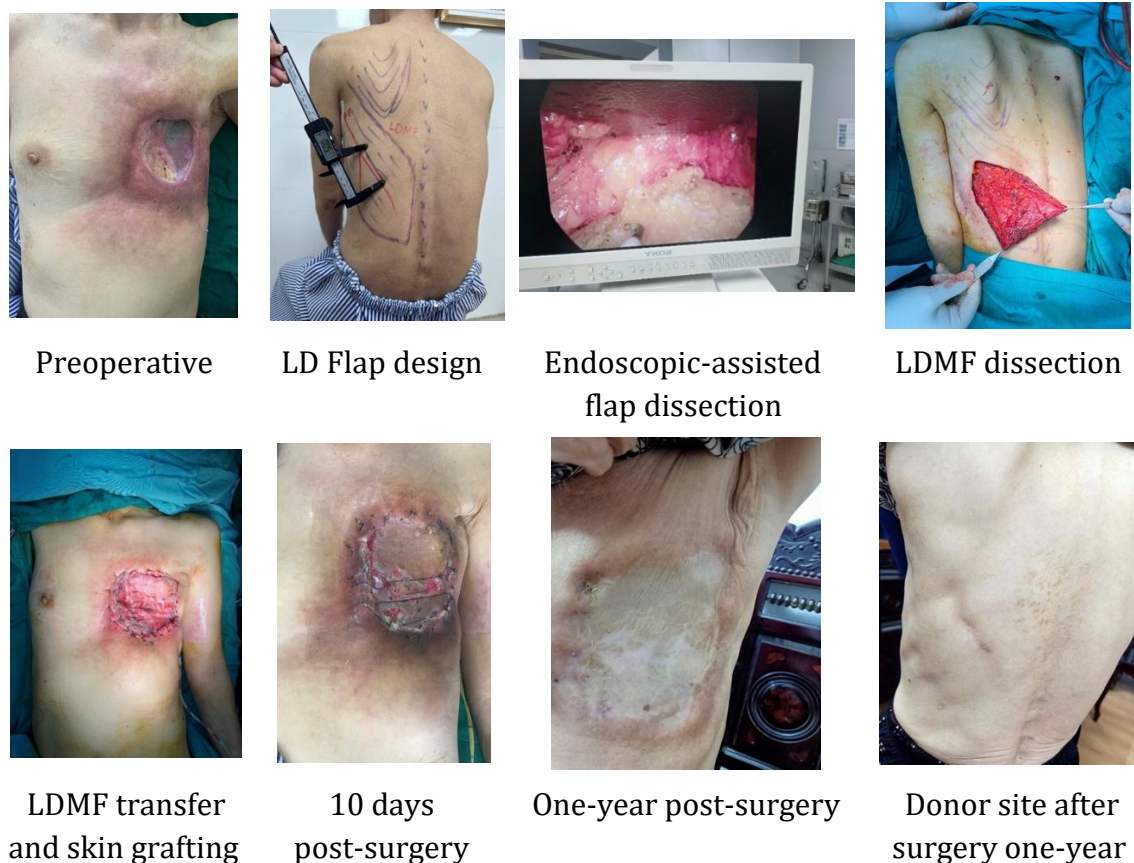


Figure 1. Case clinical report

(Patient: *Vuong Thi Th*, 65 years old. Medical record number: 22009882)

DISCUSSION

1. Anatomical and physiological rationale for flap selection

The reconstruction of large chest wall defects, particularly chronic defects on an irradiated background, presents a formidable clinical challenge. The pathophysiology of radiation injury is characterized by progressive obliterative endarteritis, leading to diffuse fibrosis, hypoperfusion, and ultimately, aseptic necrosis [4]. This compromised bed loses its regenerative capacity and fails to form granulation tissue. Consequently, simple coverage methods such as classic split-thickness skin grafting almost invariably fail due to the lack of a receptive vascular bed [3]. Consequently, the fundamental surgical principle mandates the radical debridement of all necrotic and fibrotic tissue and, crucially, the importation of a robust, independent blood supply from outside the zone of injury [8].

Large-scale analyses by Arnold and Pairolero [1] and Bakri et al. [2] have identified the LD flap as the premier choice due to its large surface area, consistent thoracodorsal pedicle, wide arc of rotation, and high reliability.

A pivotal aspect and technical focus of this study was the exclusive use (100%) of the muscle-only flap covered by

split-thickness skin grafts, rather than the conventional myocutaneous flap [2]. This technical decision was predicated on two theoretical advantages:

At the recipient site, the muscle surface provides an excellent, vascularized bed, ideal for skin graft take. The muscle flap possesses superior pliability, allowing it to obliterate dead space and conform to the complex 3D contours of the chest wall more effectively than bulky myocutaneous flaps. Furthermore, the rich perfusion of the muscle serves to enhance the delivery of systemic antibiotics and immunologic mediators to the lesion, thereby facilitating the control of chronic infection.

At the donor site, this is a distinct advantage. Preserving the entire dorsal skin allows for tension-free primary closure of the donor site. This significantly reduces morbidity compared to the traditional myocutaneous flap technique, which often necessitates closing the donor defect under tension or requires additional skin grafting on the back.

In summary, the muscle-only flap was selected for its ability to successfully break the "pathological cycle" of chronic lesions, "re-establishing" the local biological environment, and converting a chronic, hypoxic, and infected wound into an acute, clean wound capable of healing.

2. Clinical efficacy

Our study corroborated the efficacy of this technical approach. The complete flap survival rate reached 96.67% (29/30 flaps). This is a highly promising outcome, particularly given that 70% of the cohort presented with defects on an irradiated background-a high-risk factor for vascular and wound healing complications. The 100% skin graft take rate on the muscle bed demonstrated the superiority of the muscle-only flap at the recipient site.

A single case of partial necrosis (3.33%) occurred in a patient with extensive necrosis, which necessitated difficult radical debridement, further complicated by diabetes. These are compounding factors, emphasizing the importance of strict control of underlying comorbidities and the necessity of radical debridement of avascular tissue before coverage.

Another critical outcome of the study is the preservation of upper limb function. At the 6-month follow-up, 100% of patients demonstrated an unrestricted range of motion in their shoulders for daily activities. This finding has significant clinical implications, reinforcing classic literature suggesting that the sacrifice of the latissimus dorsi muscle (in the general population, excluding professional athletes) causes negligible functional impairment.

The aggregate results - including no cases of recurrent ulceration, favorable flat scars at both recipient and donor sites (evidenced by 100% primary healing at the donor site), and 100% functional preservation - culminated in a 100% patient satisfaction rate. This confirms that the surgery successfully achieved its ultimate goal: the restoration of the patient's quality of life.

3. Latissimus dorsi flap harvest techniques

A primary objective of the study was to compare the two harvest techniques. The endoscopic approach demonstrated a distinct superiority in terms of aesthetics. The mean incision length (4.73 cm) was significantly shorter than that of the open technique (18.13 cm) ($p < 0.05$). This maximizes the reduction of scarring sequelae on the back, addressing a common patient complaint, which aligns with Ramakrishnan's report on the aesthetic benefits of endoscopic surgery [8].

Conversely, the conventional open technique allowed for more rapid dissection. The operative time for the endoscopic approach (2.73 hours) was significantly longer than that of the open approach (2.23 hours) ($p < 0.05$). This prolonged duration is a well-documented trade-off in the literature, attributed to the learning curve and the

technical demands of manipulating instruments within a confined optical cavity. Regarding wound-healing time, the endoscopic surgery group showed the most pronounced reduction at the recipient site, with 15.93 ± 3.6 days compared to 22.2 ± 14.04 days in the open surgery group (a difference of approximately - 6.27 days). The large standard deviation in the open group suggests greater heterogeneity and possibly cases with prolonged healing. At the donor site, healing time in the endoscopic group (13.87 ± 3.04 days) was comparable to that in the open group (14.93 ± 8.18 days), with only a minimal difference. In terms of length of hospital stay, endoscopic surgery tended to be shorter (30.4 ± 24.04 days) than open surgery (33.8 ± 19.54 days; difference -3.4 days); however, the large standard deviations in both groups suggest substantial overlap, and hospital stay may be influenced by defect severity, comorbidities, postoperative complications, and variations in postoperative care pathways.

Technique selection should be individualized: Conventional open surgery remains suitable for massive, complex infected defects requiring speed. Alternatively, endoscopic surgery is the ideal modality when prioritizing aesthetics and minimizing donor site invasiveness.

CONCLUSION

The pedicled latissimus dorsi muscle flap is a safe and highly effective modality for reconstructing large chest wall defects, yielding high flap survival rates and excellent functional recovery. Compared to the traditional open technique, the endoscopically-assisted approach offers clear superiority in terms of aesthetics by minimizing the donor site scar.

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