

Original Article

Comparative Analysis Of Donor Site Morbidity and Rates Of Seroma Formation In Extended Versus Muscle-Only Latissimus Dorsi Flaps

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Abstract

Objective: To compare the incidence of seroma formation and donor site morbidity between Extended Latissimus Dorsi (ELD) flaps and muscle-only Latissimus Dorsi (MLD) flaps in reconstructive surgery.

Methods: A comparative cross-sectional study was conducted at the Department of Plastic Surgery, Shifa International Hospital, Islamabad. A total of 60 patients undergoing breast reconstruction, upper and lower limb reconstruction after tumor resections or trauma and functional muscle transfers in brachial plexus injuries with either ELD (n=30) or muscle-only LD (n=30) flaps were included. Data on demographics, comorbidities and postoperative complications such as seroma formation, wound infection, skin necrosis, dehiscence, and pain (VAS) were collected over a 3-month follow-up period. Statistical analysis was performed using SPSS version 26.0, with significance set at $p < 0.05$.

Results: Seroma formation was significantly higher in the ELD group (43.33%) compared to the MLD group (10%) ($p < 0.001$), with a greater mean seroma volume (97.7 ± 38.5 ml vs. 25.2 ± 12.1 ml). Pain scores on Day 1 and at 1 month were also significantly higher in the ELD group ($p < 0.01$). Other complications—wound infection, skin necrosis, and dehiscence—were more frequent in the ELD group but not statistically significant. Seroma recurrence was also more prevalent in the ELD group.

Conclusion: The ELD flap has been associated with significantly higher donor site morbidity, particularly seroma formation and postoperative pain, when compared to the muscle-only LD flap. These results indicate that ELD flaps can yield increased tissue volume with increased risk of complications and warrant careful consideration to improve operative techniques

Keywords: Mastectomy, Morbidity, Seroma.

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RM, MR, SURS, MIK, SM, FA - Conception, Design
RM, MR, SURS, MIK, SM, FA - Acquisition, Analysis, Interpretation
RM, MR, SURS, MIK, SM, FA - Drafting
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Introduction

The latissimus dorsi (LD) flap is widely used in breast reconstruction, particularly following mastectomy, as well as upper and lower limb tumor and trauma cases and brachial plexus injury because of its ability to provide a sufficiently large volume of tissue for reconstruction. The Latissimus Dorsi (LD) flap continues to be a widely used method of reconstruction based upon its reliability and its strong vascularity. Nevertheless, donor site morbidity, especially seroma formation, is a frequent postoperative complication that may affect patient recovery and satisfaction.¹ Although very effective, this procedure is linked to a variety of complications especially related to the donor site that affect patient outcomes and recovery.² Amongst the other donor site-related complications, the most prevalent are seroma formation and the morbidity associated with seroma (including pain and delayed wound healing).³ Seroma, a fluid buildup that develops after surgery and occurs beneath the skin, is a common complication after the extended LD flap procedure. In the presence of this fluid collection, there is a prolonged recovery period, the danger of infection, and sometimes the need for subsequent surgical measures (drainage and drain insertion).⁴ Seroma forms due to the inflammatory response to the surgical site and the acute phase of wound healing. Seroma formation then further leads to donor site skin flap necrosis, wound dehiscence, multiple visits to the hospital and physician after surgery and delayed recovery.⁵ Several factors contribute to the development of seromas, including the extent of tissue dissection, the prolonged use of drains, and patient-related variables such as body mass index and comorbidities.⁶ The tissue harvested either with the extended LD (ELD) flap, which includes additional fat and skin as shown in Figure 1, or the muscle-only LD (MLD) flap, significantly influences seroma formation rates and overall donor site morbidity. Extended LD Flaps help increase the volume, so they reduce the need for breast implants. Higher rates of seroma formation are linked to additional removal of tissue, which causes disruption of lymphatic drainage as well as more dead space. The ELD flap harvest technique requires a larger dissection area, leading to

greater disruption of lymphatic drainage and increased dead space, which may contribute to a higher risk of seroma formation and other donor site complications. In contrast, the MLD flap, which spares fat and skin, results in lower donor site morbidity, but it often requires additional volume augmentation methods to achieve optimal reconstructive outcomes in cases of breast reconstruction.⁷ According to recent data from The Global Cancer Observatory, more than 2 million new cases of breast cancer were diagnosed in 2018.⁸ A study conducted by Hyungsuk Kim et al found that Donor-site seroma occurred in 2 LD patients (5.6%) and in 23 ELD patients (62.2%).⁹ So, this study aims to compare the incidence of seroma formation and overall donor site morbidity with the extended versus muscle-only LD flap, providing evidence-based insights for surgical decision-making. Latissimus dorsi flap reconstruction is a technique most commonly used by plastic and reconstructive surgeons for breast reconstruction and soft tissue defects. Seroma formation remains the most common postoperative concern. However, the extended LD Flap, including overlying skin paddle and fat, as compared to the LD Flap with only muscle, has increased donor site morbidity and severity of seroma formation.

By comparing these two approaches, the study aims to identify differences in recovery, complication rates, and overall patient outcomes, ultimately guiding surgical decisions to improve patient care, minimize complications, and optimize aesthetic and functional results.



Figure 1: Schematic representation of Extended latissimus dorsi (ELD) flap harvest technique (A) preoperative marking of flap design, (B) elevation of latissimus dorsi muscle with overlying tissue, (C) de-epithelization of extended latissimus dorsi flap skin, (D) breast mound creation with ELD flap, (E) immediate donor site closure, and (F) late postoperative donor site scar

Materials And Methods

A comparative cross-sectional study was conducted for 3 months from 29th May 2025 to 29th August 2025, in the Department of Plastic Surgery at Shifa International Hospital, Islamabad. The study population was selected from patients who had undergone reconstruction with the latissimus dorsi (LD) flap.

Patients included were those who had undergone or were scheduled to undergo reconstruction with LD flap for aesthetic or reconstructive purposes, such as breast reconstruction, soft tissue defect coverage after tumor resections or trauma, or functional muscle transfer. Inclusion criteria also covered patients with surgical indications for the flaps required for residual functional deficit following brachial plexus injury. Typically, these were adults aged 18 to 75 years. Patients included in this study had healthy donor sites, with no clinical signs of infection, such as cellulitis or abscess, at the time of surgery and no previous surgery involving the same operative site. Patients with controlled comorbidities, including diabetes, hypertension, or obesity, confirmed through medical history, were also included.

Exclusion criteria comprised patients with previous surgeries involving the donor site, active infections either at the surgical site or systemic infections at the time of surgery, as such conditions could skew the results regarding donor site morbidity. Patients with a prior history of an attempt to harvest a latissimus dorsi flap were excluded due to potential interference from scar tissue or compromised vascularity. Additionally, patients with recurrent cancer, particularly breast cancer, were excluded due to the potential impact on wound healing and risk of complications like seroma formation.

The duration of the study was three months, including data collection and follow-up, and the desired sample size was achieved, following approval from CPSP. Ethical clearance was obtained from the review board of the Department of Plastic Surgery, Shifa International Hospital, Rawalpindi.

The sample size for both the LD and extended LD (ELD) groups was calculated using the WHO sample size calculator. A total of 60 patients were enrolled, with 30 in each group, based on a significance level of 5%, test power of 80%, and estimated population proportions of 5.6% for the LD group and 62.2% for the ELD group. A non-probability consecutive sampling technique was used.⁹ Patient medical records were reviewed, and data collection was conducted by trained medical professionals following established protocols to maintain consistency and accuracy. Routine investigations such as complete blood count, urine analysis, liver function tests, and renal function tests were performed.

A structured data collection form was used to capture demographics (age, gender, BMI, smoking status, comorbidities), surgical details (type of flap, surgeon, operative time, drain placement, intraoperative complications), and postoperative outcomes (seroma

presence and volume, donor site morbidity). Follow-up assessments occurred on postoperative Day 1, Week 1, Weeks 2–4, and at 3 months.

Key outcome measures included seroma formation (in milliliters), donor site complications (infection, wound dehiscence, pain, skin necrosis). Pain was assessed using the Visual Analogue Scale (VAS), and other complications, including seroma recurrence and infection, were documented.

In the preoperative phase, informed consent was obtained, and baseline clinical data were collected. Intraoperative details, including flap type and complications, were recorded during surgery. Postoperative follow-up focused on donor site assessment and seroma evaluation at designated intervals.

All data were entered into a secure electronic database with regular checks for completeness and accuracy. This ensured accurate data collection for comparison of morbidity rates and seroma formation between extended LD and Muscle LD techniques.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Comparative analysis between ELD and Muscle LD groups accounted for potential confounding variables such as age, BMI, comorbidities (e.g., diabetes), smoking status and postoperative care. Flap harvesting methods and drainage management were also considered.

Qualitative variables such as gender, comorbidities, seroma formation, wound infection, dehiscence, and skin necrosis were summarized using frequencies and percentages. Quantitative variables, including age, BMI, height, and pain scores, were reported as means and standard deviations. Group comparisons were conducted using the Chi-square test. Effect modifiers like age, comorbidities, new admissions, and prior chemotherapy or radiotherapy were controlled through post-stratification. A p-value of <0.05 was considered statistically significant.

Results

A total of 60 patients were included in the study — 30 in the Muscle LD group and 30 in the Extended LD group. The mean age of the participants was 52.1 ± 8.9 years, and the majority were female (75%). No statistically significant differences were found between the groups in terms of age, BMI, comorbidities, or smoking status, ensuring comparability between the cohorts.

Table 1: Baseline Demographics and Clinical Characteristics

| Variable | Muscle LD (n=30) | Extended LD (n=30) | p-value |
|-------------------------------|------------------|--------------------|---------|
| Age (years) | 51.4 ± 9.2 | 52.8 ± 8.7 | 0.42 |
| Gender (Male/Female) | 11 / 19 | 13 / 17 | 0.65 |
| BMI (kg/m ²) | 26.7 ± 3.4 | 27.3 ± 3.6 | 0.31 |
| Smokers (%) | 9 (30%) | 6 (20%) | 0.39 |
| Diabetes Mellitus (%) | 13 (43.33%) | 15 (50%) | 0.66 |
| Hypertension (%) | 14 (46.6%) | 16 (53.33%) | 0.67 |
| Chemotherapy/Radiotherapy (%) | 8 (26.66%) | 9 (30%) | 0.79 |
| Mean Operative Time (mins) | 104.2 ± 13.8 | 133.4 ± 17.6 | <0.001* |

*Statistically significant ($p < 0.05$)

Table 2: Postoperative Outcomes

| Outcome | Extended LD (n=30) | Muscle only LD (n=30) | p-value |
|-------------------------------------|--------------------|-----------------------|---------|
| Mean Seroma Volume (ml) | 97.7 ± 38.5 | 25.2 ± 12.1 | <0.001* |
| Wound Infection (%) | 6 (20%) | 3 (10%) | 0.29 |
| Wound Dehiscence (%) | 3 (10%) | 1 (3.33%) | 0.31 |
| Skin Necrosis (%) | 2 (6.66%) | 0 (0%) | 0.15 |
| VAS Pain Day 1 (mean \pm SD) | 5.6 ± 1.3 | 4.2 ± 1.0 | <0.01* |
| VAS Pain at 1 month (mean \pm SD) | 2.9 ± 0.9 | 2.0 ± 0.7 | <0.01* |
| Seroma Recurrence (%) | 2 (6.66%) | 0 (0%) | 0.04* |

*Statistically significant ($p < 0.05$)

Seroma formation was significantly more common in the extended LD group 13(43.3%) compared to the Muscle LD group 3 (10%) ($P < 0.001$). The mean seroma volume and pain scores at Day 1 and at 1-month follow-up were also significantly greater in the extended LD group compared to the muscle-only LD group. There was a higher incidence of Wound infection, necrosis and dehiscence rates in the extended LD group, but it was not statistically significant.

Seroma formation incidence and volume are significantly higher in the extended LD group. Pain scores and functional impairment were higher in the Extended LD group and indicated increased donor site morbidity. Other complications of infection, dehiscence and skin necrosis showed a trend toward higher rates within extended LD, but were not statistically significant.

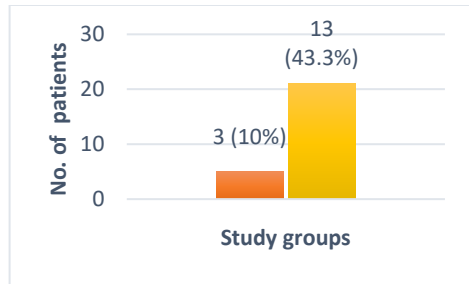


Figure 2: Incidence of seroma Formation among study groups (n=60)

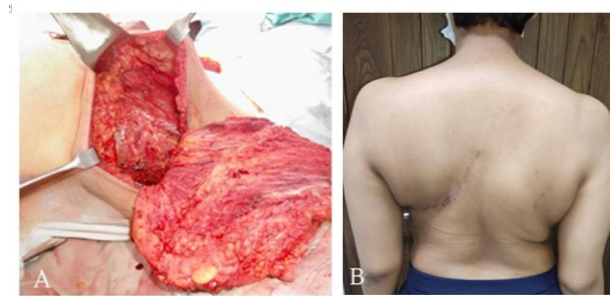


Figure 3: Pictorial representation of muscle-only latissimus dorsi flap (MLD) (A) muscle-only latissimus dorsi flap harvest (B) healed donor site

Discussion

Results of the present study showed that seroma rates were significantly higher in patients with extended Latissimus Dorsi (ELD) flap harvest (43.3%) than in patients with muscle-only Latissimus Dorsi (MLD) flaps (10%). Furthermore, the mean seroma volume was significantly larger in the ELD group ($97.7 \pm 38.5\text{ml}$) than in the MLD group ($25.2 \pm 12.1\text{ ml}$) (Table II, $P < 0.001$). These results suggest that, with good operative techniques, donor site morbidity in terms of seroma formation and volume may actually be less than that traditionally assumed.

When compared with the international literature, our incidence of seroma in the ELD group (43.3%) is consistent with that previously reported in international studies, which generally range between 15% and 60%.¹⁰ Rather, the seroma rate in our MLD cohort (10%) is lower than most of the published literature, with described rates ranging from 12% to 25%.^{11,12} For example, in a Korean retrospective series, the incidence of donor-site seroma after immediate LD flap reconstruction was 12.3%.¹³ In a single-center study from Germany, Banys et al. reported a donor site seroma rate of 26% in patients undergoing extended latissimus dorsi (ELD) flap reconstruction.¹⁴ This implies that technical refinements used during ELD harvest in our setting have produced better results: quilting of donor site skin, careful hemostasis, and tension-free closure.

A reason for the decreased seroma formation in the ELD group may be the dissection method. Also, dead space and disruption of lymphatics could be reduced by elevating the flap between two different layers of fat, rather than through a thick layer of adipose.¹⁵ Additionally, careful hemostasis and quilting sutures to eliminate possible dead spaces are reported to further reduce seroma formation risk.¹⁶ Similar findings have been documented by Debry et al, who stated the importance of meticulous dissection and quilting in reducing donor site complications.¹⁷ Our findings support these technical changes as a contributing factor for the decrease in seroma incidence and volume in the ELD group.

This is further supported by other seroma volume analyses. The mean aspirated volume in the ELD group (about 98 ml) is significantly larger than volumes reported in previous international studies, which vary between 50 and 80 ml.¹⁸ In contrast, the MLD group had very low seroma volumes, being in line with the lower end of previously reported data.¹⁹ Importantly, no recurrences were observed in the MLD group, whereas 2 (.66%) of the patients in the ELD group had recurrence of seroma, highlighting the protection offered by the extended dissection plane and quilting technique.


This trend is similar to other studies, and in particular, Escandon et al. found seroma to be the most frequent donor site complication following latissimus dorsi flap harvest, while other morbidities, including infection, wound disruption, and necrosis, are less common.²⁰ Pain scores were also higher in the ELD group, suggesting greater donor site morbidity than the MLD flap. Taken together, our findings indicate that the MLD flap (Figure 2) may actually provide benefits in donor site outcomes with decreased seroma formation, seroma volume, and morbidity but at the cost of decreased tissue volume and concomitant need for breast implants. This also contrasts with some previously published reports associating long surgeries with increased rates of complications, emphasizing the role of technique, hemostasis and postoperative management in determining outcomes.

Conclusions

This study demonstrates that the Extended Latissimus Dorsi (ELD) flap is associated with significantly higher rates and volumes of seroma formation than the muscle-only LD flap. But they can be minimized with improved operative techniques. It is also correlated with increased pain and a slightly higher risk of wound dehiscence. Although both of these techniques are effective reconstruction modalities, the ELD flap has the additional benefit of obviating the need for implants during breast reconstruction.

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