# ORIGINAL ARTICLES

## THE LATISSIMUS DORSI FLAP FOR THE RECONSTRUCTION OF COMPLEX CHEST WALL DEFECTS: IS A POLYPROPYLENE MESH AND A FLAP ENOUGH?

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## ABSTRACT

***Objective:*** To determine the outcomes of the use of the Latissimus Dorsi Flap for the Reconstruction of Complex Chest Wall Defects: Is a polypropylene mesh and a flap enough?

***Study Design:*** Descriptive case series.

***Place and Duration of Study:*** The study was conducted in the department of Plastic and Reconstructive Surgery Shifa International Hospital Islamabad, over a period of 5 years between Jan 2012 and Dec 2016.

***Material and Methods:*** All patients with chest wall defects, post tumor resection diagnosed on tissue biopsy, trauma, osteoradionecrosis and infection were included in this study. The chest wall was reconstructed with a polypropylene mesh and the latissimus dorsi flap. All the patients with tumors were discussed in multidisciplinary team meeting. Patients with post coronary artery bypass surgery wounds were excluded from this study. Demographic data including age, sex, histopathological diagnosis of disease and other outcomes were studied.

***Results:*** Total 22 patients were included in this study over a period of 05 years, 16 patients with tumors. Age range was 12 to 63 years. Mean follow up time was 3 years. Six patients developed postoperative complications: one patient had partial skin graft loss at the recipient site. Two patients developed partial wound dehiscence one at the donor area and other at the flap inset site. One patient had partial distal flap loss and graft loss at donor area. There was no mortality in our series.

***Conclusion:*** Our study revealed that the polypropylene mesh covered with the latissimus dorsi myocutaneous flap is adequate for skeletal stabilization of composite chest wall defects achieving satisfactory functional and aesthetic results.

**Keywords:** Chest Wall Reconstruction, Chest Wall Tumors, Latissimus dorsi flap, Pedicled flap, Polypropylene mesh.



## INTRODUCTION

Chest wall reconstruction is a challenge for the Reconstructive surgeon because it requires practice of the fundamentals of reconstructive surgery to restore form and function. Large and life-threatening chest wall defects result from the treatment of trauma, tumors, infected post coronary bypass sternal wounds, congenital anomalies, and radiation injury. These defects require timely reconstruction to restore chest wall integrity and soft tissue closure[1]. The essential goal is to eliminate dead space, achieve chest wall stability and provide wound closure[2,3].

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*Received: 18 Jan 2017; revised received: 14 Mar 2017; accepted: 18 Mar 2017*

Full thickness defects involving all the tissue layers can usually be reconstructed reliably and immediately, in order to maintain the strengthand integrity of the chest wall, to protect and cover the unprotected vital organs and to allow early recovery[4]. Principal factors to be kept in mind are coverage with vascularised tissue, the effects in respiratory mechanics resulting from development of large chest wounds, and the requirement for immediate coverage for vital underlying organs[1]. Reconstructive Goals include: Wound closure with maintenance of intrathoracic integrity, restoration of aesthetic contour, as well as minimization of donor site deformity. The superficial defects involving the soft tissues only are easy to treat by successfully using skin grafts or local flaps. Composite defects

requiring coverage and protection of underlying vital structuresdemands different reconstructive options[5].

The selection of reconstructive options is based on the nature, size and location of the defect[4].

Before any major resection, careful planning of the reconstruction possibilities by a multidisciplinary team is mandatory.

Modern day chest wall reconstruction involves the full range of the reconstructive armamentarium including negative pressure wound therapy, local flaps, pedicled flaps and free tissue transfer. The Latissimus dorsi is the most reliable and versatile flap available for use in reconstructive surgery today. Tanasini, first described the latissimus dorsi musculocutaneous flap for coverage of a chest wall defect after mastectomy[6]. The latissimus dorsi is an expendable muscle in patients with intact and synergistic girdle muscles[7]. The latissimus dorsi muscle flap and musculocutaneous flap remain the first options as workhorse in chest wall reconstruction. The thoracodorsal neurovascular pedicle is one of the most reliable units available[8]. It is best suited for anterior and anterolateral defects, but can reconstruct any defect of the chest[2].

Synthetic materails like polypropylene mesh alone as well as methylmethacrylate placed between the two layers of a mesh, one or two rib grafts fixed to the mesh, can be used to give additional stability in extensive defects to prevent paradoxical movement[4].

The aim of this study is to evaluate and present our experience of the use and efficacy of the latissimus dorsi myocutaneous flap with a double polypropylene mesh for soft tissue coverage as well skeletal stabilization of composite chest wall defects to achieve functional and aesthetic results.

## MATERIAL AND METHODS

This study (descriptive case series) was conducted in the Departmant of Plastic and Reconstructive Surgery, Shifa International Hospital Islamabad from January 2012 to December 2016. Consecutive non-probability sampling was done. During this period a total of 22 patients were operated on for reconstruction of the chest wall defects following resection of chest wall for various etiologies. All chest wall defects produced after tumor resection (diagnosed on tissue biopsy), trauma, osteoradionecrosis (after radiotherapy for Carcinoma breast) and infection were included in this study. Patients with post coronary artery bypass surgery wound dehiscence were excluded from this study. CT scans were used to determine the extent of local disease as well as to rule distant metastases to the chest and abdomen. Baseline hematological and biochemical investigations were done and the co-morbid illnesses were managed accordingly.

All the patients with tumors were discussed in Multidisciplinary clinic. All the patients who were counseled in detail about the management, after approval from the joint panel were booked for surgery.

Majority of patients required a polypropylene mesh for skeletal support followed by coverage with the latissimus dorsi myocutanous flap.

Chest tube intubation with under-water seal was used for the drainage of the pleural cavity. Suction drains were placed in the donor area of the latissimus dorsi flap as well as under the flap at the recipeint area. Patients with resection of the chest wall skeleton were nursed for at least 24 hours in the intensive care unit post-operatively and were kept on ventilatory support as advised by anaesthetist. All patients were weaned off successfully after 24 hours. Chest drain was removed post-operatively in liaison with the cardiothoracic and the general surgical team when safe. The suction drains were removed when the drainage was less than 30cc over 24 hours.

Patients were discharged on the 5th post-operative day and then asked for 1st followup

after 5 days of the date of discahrge. On the first followup the patient was evaluated for flap viability, wound infection, donor site hematoma/ seroma formation, graft loss at donor site and wound dehiscence. After complete wound evaluated for tumor recurrence over this followup period.

The statistical data analysis was done in SPSS version 21. Demographic data including age, sex, histopathological diagnosis of disease

**Table: Summary of Patients of the study.**

| S No | Age/Sex | Etiology | Location of Defect | Size of the Defect (cm) | No. of Ribs Resected | Type of Resection |
|---|---|---|---|---|---|---|
| 1. | 29/Female | Recurrent Carcinoma Left breast | Left anterior chest | 10 x 12 x 6 cm | - | |
| 2. | 35/Male | Condrosarcoma Sternum | Anterior Chest | 10 x 7 x 7 cm | - | |
| 3. | 45/Female | Recurrent Sarcoma | Right Anterior chest | 21 x 20 x 12 cm | 5 | Ribs |
| 4 | 31/female | Lumbosacral fibromatosis | Right posterior chest | 15 x 14 x 8 cm | | |
| 5 | 13/female | Recurrent Ewing's Sarcoma | Right Anterior chest | 12 x 5 x 3 cm | 3 | Ribs |
| 6 | 35/female | Synovial Sarcoma | Right Anterior chest | 13 x 11 x 8 cm | 2 | Ribs and part of sternum |
| 7 | 14/female | Recurrent Ewing's sarcoma | Right Lateral chest | 11 x 3.5 x 2.5 cm | 3 | Ribs |
| 8 | 35/female | Synovial Sarcoma Right Chest Wall | Right Anterior chest | 12 x11 x 7 cm | 2 | Ribs, part of Right clavicle and manubrium sterni |
| 9 | 12/female | Dermatofibrosarcoma protuberans | Right Posterior Chest | 8 x 5.5 x 2 cm | - | |
| 10 | 49/male | Osteosarcoma Sternum | Anterior Chest | 14 x 14 x 6 cm | 5 | Part of Sternum and ribs |
| 11 | 21/female | Recurrent Ewing's Sarco2ma | Right Anterolateral Chest | 14 x 11 x 3 cm | - | |
| 12 | 50/female | Recurrent Invasive Ductal Carcinoma Right breast | Right anterior chest | 10 x 6 x 5 cm | - | |
| 13 | 35/female | Synoival Sarcoma | Right Anterior chest | 4.5 x 4 x 2 cm | - | |
| 14 | 20/female | Invasive ductal carcinoma Left Breast | Left anterior chest | 12 x 5 x 4 cm | - | |
| 15 | 60/female | Invasive Mammary carcinoma Left breast | Left anterior chest | 21 x 15 x 5 cm | 4 | Sternum and Ribs |
| 16 | 25/female | Metaplastic Carcinoma Left breast | Left anterior chest | 21 x 16 x 11 cm | 3 | |
| 17 | 33/male | Recurrent Dermatofibrosarcoma protuberans | Left posterior chest | 20 x 6 x 2 cm | - | |
| 18 | 60/female | Infected drainaing sinuses right anterior chest and axilla | Right anterior chest | 17 x 9 x 1.5 cm | | |
| 19 | 62/female | Recurrent Liposarcoma | Left anterior chest | 11.5 x 10.5 x 6 cm | | |
| 20 | 30/male | Synovial Sarcoma | Right Posterior chest | 19 x 13 x 8 cm | | Right Scapula |
| 21 | 63/male | Recurrent Rhabdomyosarcoma | Left Anterolateral Chest | 6 x 5.5 x 4 cm | 3 | Ribs |
| 22 | 34/female | Synovial Sarcoma | Posterior chest midline | 20 x 11 x 8 cm | | |

healing and removal of stitches patients were referred to oncologist for adjuvant chemo-radiotherapy.

The follow up was weekly for 1 month and then 3 monthly for the first year, 6 monthly for second year and then yearly. Patients were and other outcomes were studied. Mean ± standard deviations was calculated for variables like age, gender, type of tumor, size of defect, ribs excised, the location of chest wall defect and the post-operative complications (graft loss, wound infection/dehiscence, hematoma/seroma and

flap loss and necrosis. All the results were presented in the form of percentages and frequencies.

## Case Reports

### Case Report 1

A 30 years old male presented with Ewing's sarcoma involving the right scapula and the surrounding postero-lateral chest wall. Wide local excision was done with resection of the scapula and the defect was reconstructed with a pedicled latissimus dorsi flap (fig-1). Patient developed adequate shoulder movements.

### Case Report 2

A 62 years old male was operated for rhabdomyosarcoma of the left anterolateral chest involving the underlying chest wall. Resection of the tumor resulted in a composite chest wall defect. The defect was reconstructed with a double polypropylene mesh covererd with a pedicled latissimus dorsi flap (fig-2).

### Case Report 3

A 60 years' old lady developed recurrent invasive carcinoma breast of the left side of the anterior chest. Wide local excision of the tumor resulted in a large composite chest wall defect which was reconstructed with a polypropylene mesh and the soft tissue coverage was provided by a pedicled myocutaneous latissimus dorsi flap. Post-operatively patient achieved functional stability with no paradoxical movements (fig-3).

**Figure-1: Ewing's Sarcoma Right Scapula and Posterolateral Chest Wall.**


**Figure-2: Rhabdomyosarcoma of The Left Anterolateral Chest Wall.**

**Case Report 4**

A 45 years old female presented with leiomyosarcoma of the right lower lateral chest wall. Resection of the tumor resulted in a composite lower lateral chest wall defect with exposed liver. The diaphragm was repaired and the chest wall defect was reconstructed with a double polypropylene mesh for skeletal stabilization followed by coverage with a myocutaneous latissimus dorsi flap. Patient didn't develop any paradoxical movements postoperatively and had no recurrence (fig-4).

## RESULTS

A total of 22 chest wall resections and reconstructions were done between January 2012 to January 2017. There were 17 (77.3%) females and 5 (22.7%) males. Their ages ranged from 12 to 63 years with a mean age of 35 years (SD ± 16.52). The majority of the chest wall defects were caused by primary chest wall tumors in 16 cases, carcinoma breast and local recurrence from breast tumors in 5, and 1 case of infection and draining sinuses. Primary chest wall tumors included synovial sarcoma in 7 patients (31.8%), carcinoma breast in 5 patients (22.7%), Dermatofibrosarcoma protuberans in 2 patients (9.1%), chondrosarcoma sternum in 1 patient (4.5%), Osteosarcoma of the sternum in 1 patient (4.5%), Ewings sarcoma in 3 patients (13.6%) and infection in 1 case (4.5%). There were five (22.7%) anterior, six anterolateral (27.3%), six lateral (27.3%) and five posterior (22.7%) chest wall defects. The dimensions of the defect ranged from 4 to 21 cm in length and from 4 to 20 cm in width.

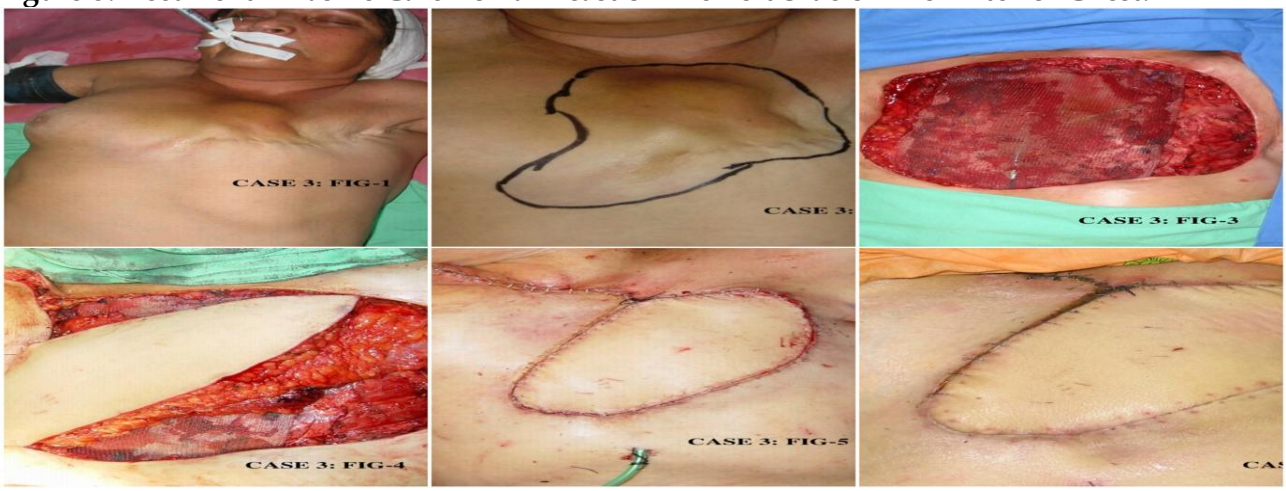
The mean size of the defect after resection was 13 cm in length and 9 cm in width (table).

The average number of ribs resected was 3. Out of the 22 patients, 9 patients represent the cases in which other bony structures were also removed in addition to ribs. Among them ribs with part of the sternum were removed in 3 (33.3%) cases, ribs in addition with sternum and clavicle in one (11.14%) case and ribs only in five (55.6%) cases.

In patients with composite defects the thoracic cage was stabilized with a double polypropylene mesh followed by coverage with the latissimus dorsi muscle flap. Muscle only was used in 2, while 20 musculocutaneous flaps were elevated. The donor site was closed primarily in 16 patients and split thickness skin graft was applied in four patients.

All patients had an uneventful recovery postoperatively. There was no mortality during the hospital stay. One of the patients developed paradoxical movement in the early and late post-operative course. Post-operatively Six patients suffered complications. One patient had partial skin graft loss at the recipient site. Wound dehiscence was seen at the donor site in 1 patient

**Figure-3: Recurrent Invasive Carcinoma Breast of The Left Side of The Anterior Chest.**



and at the recipient site in 1 patient. One patient had partial distal flap loss and graft loss at donor area. All managed conservatively with daily dressings. A secondary procedure was required in one patient to manage the wound.

Postoperatively chemo and radiotherapy was given to 21 patients after discussing the cases in multidisciplinary team meeting.

The follow up was weekly for 1 month and then 3 monthly for the first year, 6 monthly for second year and then yearly. Patients were evaluated for tumor recurrence as well as paradoxical movements in normal daily activities over this followup period.

Two patients with a developed a recurrence of tumor and were referred to the oncologist.

**Figure-4: Leiomyosarcoma of The Right Lower Lateral Chest Wall**


## DISCUSSION

Immediate reconstruction of the large composite chest wall defects has allowed the cardiothoracic and general surgeons to get oncological clearance with extensive resections not worrying about the reconstruction.There can be loss of soft tissue only or a composite defect defect involving loss of skeleton as a result of tumor excison. Defects of different dimension and depth can result from trauma, infection and radiation[9]. Therefor a complete understanding of the chest wall function and dynamics in addition to different reconstrcutive techniques is essential to reconstruct the chest wall defects which will maintain life itself[8,10,11].

Mansour et al[12] state that immediate reconstruction of large chest wall defects resulting from resection of tumors with wide margins, infection, trauma and post-osteoradionecrosis is effective and safe[12]. Immediate simultaneous reconstruction was done in this study and is comparable with the study of Hameed et al[13].

In this study the of cases were treated as per the multidiscipinary team approach[14,15]. The chest wall tumors were resected by the cardiothoracic and general surgeons followed by reconstruction of large anterior and antero-lateral defects was done with the latissimus dorsi flap by the plastic surgeon in a mutlidisciplinary team approach as advocated by arnold et al[8] and lardiniosis et al[10] to prevent a high postoperative morbidity. This approach resulted in a decreased incidence of post operative morbidity. The procedure was safe and yielded acceptable functional as well as aesthetic results helping to restore both form and function of the chest wall. Makboul et al[16] have also used the latissimus dorsi flap in reconstruction of chest wall defects[16]. The Latissimus dorsi is the most reliable and versatile

flaps available for use in reconstructive surgery today. Tanasini, first used the latissimus dorsi musculocutaneous flap for reconstruction of a post mastectomy chest wall defect[6,17]. This flap then later became the workhorse flap for chest wall reconstruction[18,19]. The latissimus dorsi is an expendable muscle in patients with intact and synergistic girdle muscles[7]. The latissimus dorsi muscle flap and the musculocutaneous flap have been and will remain the suitable options as workhorse flaps in chest wall reconstruction. They are based and raised on the the dominant thoracodorsal pedicle[8]. It is ideally suited for anterior and anterolateral defects, but was used successfully in all the defect locations[2,20]. The latissimus is also suited to closure of posterior thoracic defects[21]. Christen et al have also used the trapezius and the latissimus dorsi flaps for upper and middle posterior chest wounds, respectively[22].

In this study we have also used the pedicled myocutaneous as well as the muscle only flap for the reconstruction of anterior, anterolateral and posterior chest wall defects. The average size of is 13x9 cm which is comparable to other studies[11,13].

The type of skeletal reconstruction and in which case it should be done involves a difference in opinion[10,23,24]. All full thickness skeletal defects that can produce paradoxical movements must be reconstructed. Arnold et al state that patient can tolerate sternectomy or resection of 4-6 ribs without respiratory insufficiency[8]. Only soft tissue coverage can be provided as a rule generally in a defect of less than 5cm in diameter on the chest wall as well as in posterior chest wall defects less than 10 cm because of support of the overlying scapula without skeletal reconstruction[11,12,24]. The average ribs resected in this study were 3 which is comparable with the study conducted by Deschamps et al[24] (3 ribs) Hameed et al[13] (3.5 ribs), Chen et al[15] (2.4 ribs) and Tan et al[11] (3.6 ribs).

The use of prosthetic material for skeletal stabilization depends on the surgeon's choice. Stability can be provided with autologous tissues like fascia lata, rib and bone. The use of autologous material has gone out of favor since synthetic mesh was started being used[25]. Prosthetic material like synthetic mesh[4] (Prolene[26], Gortex[27], Vicryl and Methylmetha-crylate[10] etc.) or ceramic, silicon prosthesis, staples and plates can also be used[8,12,24]. Sedar et al have advocated that skeletal stability must be established with prosthetic or bio-prosthetic materials alone or together[14]. Bio-absorbable plates have also been used in malignant chest wall tumor defects in pediatric population[28]. In our study we have used the polypropylene mesh doubled on itself similar to the technique of doubled knit mesh described by Arnold et al[8] and Harati et al[29]. This technique provided good support to our patients and there was no significant evidence of paradoxical movements clinically postoperatively. Mansour et al also only used the polypropylene mesh in their study with good satisfaction[12].

Post operative complications leading to morbidity have been low in our study which are comparable with Hameed et al[13] with no flap losses.

## CONCLUSION

Our study revealed that the polypropylene mesh covered with the latissimus dorsi myocutaneous flap is adequate for skeletal stabilization of composite chest wall defects achieving satisfactory functional and aesthetic results.

## CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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