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Research Article

Comparison of Muscle Sparing Latissimus Dorsi Flap Vs Split Thickness Skin Graft for Post Burn Inframammary Fold Contracture Release in Terms of Contracture Recurrence and Breast Contour

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Abstract

Background: Childhood thermal injuries of anterior chest wall lead to developmental breast abnormalities. Conventional IMF release methods include release of restrictive scars and addition of thick split thickness skin grafts (STSG). However, it may lead to recurrence, poor skin texture and projection deformity. The pedicled muscle sparing latissimus dorsi (MSLD) flap overcomes these complications.

Objective: The aim of this study is to compare the outcomes between these two procedures in terms of contracture recurrence and breast aesthetics and donor site morbidity.

Methodology: It was a randomized control trail conducted for a period of one year from April, 2023 to April, 2024 at Jinnah burn & reconstructive surgery Centre, Lahore. Post-pubertal females with small to medium sized breast having post-burn IMF contracture and lower pole projection deformity were included. Lower pole breast reconstruction was done either with MSLD flap or STSG. Patients were randomly allocated to one of the two groups. Three months postoperatively, patients were assessed for breast aesthetics using modified breast aesthetic scale, latissimus dorsi function, Vancouver scar scale and contracture recurrence.

Results: Out of Eighteen patients, thirteen were reconstructed with horizontal skin paddle MSLD flap and rest with STSG. Scar characteristic, breast aesthetic score and over all satisfaction were better for MSLD then STSG group ($P<0.05$). Contracture recurrence was noted only in two patients and both were reconstructed with thick split thickness skin graft.

Conclusion: For IMF contracture release, the Pedicled MSLD flap offers an indispensable tool to the arsenal of reconstructive surgeon in post-burn breast reconstruction. It offers superior aesthetic results and minimal recurrence as compared to STSG without increased morbidity.

Received | 23-09-2024 **Revision** | 06-12-2024 **Accepted** | 19-12-2024

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Keywords | Post-burn breast deformity , Inframammary fold contracture, muscle sparing latissimus dorsi flap, split thickness skin graft.

Introduction

Childhood thermal injuries affecting the anterior chest wall often lead to notable deformities in breast contour during puberty. This impedes normal breast development, primarily due to extensive scarring and contractures, resulting in a projection deformity rather than parenchymal damage to the breast.[1] Nonetheless, breast mound deficiency, disfigurement and asymmetry significantly impact the emotional well-being of the patient.[2]

Particularly, inframammary fold (IMF) definition and the lower pole area of the breast plays a pivotal role in breast contour formation.[3] Post-burn scarring in this region often leads to projecting deformity and the downward displacement of the NAC due to Inframammary Fold (IMF) contracture.

Conventional methods for correcting IMF deformities typically involve releasing restrictive scars and reconstructing with thick split-thickness or full thickness skin grafts.[4] However limitations of skin graft in inframammary sulcus include inadequate improvement in projection deformity , altered skin texture, poor graft take and contracture recurrence.[5]

Alternative viable options encompass Z-plasty, local/regional flaps, pre-expanded flaps, fat grafting, free flaps and reconstruction with breast prostheses in severe deformity.[6] An ideal reconstruction technique should comprehensively address breast mound deficiency, NAC deformity, breast contour and volume concerns[7].

The Pedicle muscle sparing latissimus Doris flap (MSLD), already described in literature for breast reconstruction, best archives these objectives.[8]

The primary objective of this study is to compare outcomes of post-burn IMF contracture release and lower pole breast reconstruction utilizing a muscle-sparing latissimus dorsi flap versus split-thickness skin grafts in terms of contracture recurrence and breast aesthetics.

Methodology

From April 2023 to April 2024, a randomized control trial at breast clinic of Jinnah burn and reconstructive surgery center, Lahore enrolled eighteen females presenting with small to medium-sized breasts, lower pole projection deformity, and inferior mammary fold (IMF) contracture. Patients were assigned randomly in 1:1, using block randomization to ensure equal size groups, to have lower pole breast reconstruction with muscle sparing latissimus dorsi flap or split thickness skin graft. All the deformities stemmed from prepubertal burns, including scald, flame, or chemical burns.

Patients with burns on their back, with history of previous flap harvest and patients having large sized breasts were excluded. Detailed procedural information was documented, and informed consent was obtained.

Preoperative assessment included a comprehensive medical history, thorough physical examination including location and type of deformity and its anatomical extent, and baseline laboratory investigations. Preoperative, Intra-operative and post-operative photographs were taken in all the patients.

The average follow-up period was three months. Patient satisfaction with breast aesthetics was evaluated using modified validated breast aesthetic scale,[9] as mentioned in Table-1.

Post-operative photographs were evaluated by a panel of two plastic surgeons and one plastic surgery resident, for breast aesthetic score. Contracture recurrence was assessed subjectively by surgeon other then the operating surgeon.

Donor site scar was assessed by using Vancouver scar scale (VSS)[10,11] Assessment of latissimus dorsi (LD) function included medical research council (MRC) muscle power scale and comparison of shoulder movements and muscle power with the non-operated side. Additionally post-operative seroma formation and hospital stay duration was also noted.

Quantifiable variables were compared between two groups using student's t-test. Data were analyzed using using SPSS-21 software. A p-value <0.05 was considered statistically significant with 95% confidence interval.

Surgical Techniques

Preoperative markings were meticulously performed with the patient in a standing position, delineating the mid-sternal line, breast meridian, inframammary fold,

Table 1: *Modified breast aesthetic scale*

	1	2	3	4	5
Breast symmetry	severe asymmetry	Moderate asymmetry	Mild overall asymmetry	Mild asymmetry	Symmetric
Volume	Severe insufficiency	Moderate insufficiency	Mild overall insufficiency	Mild insufficiency	Proportionate volume
Contour	Severe contour deformity	Moderate contour deformity	Mild overall contour deformity	Mild contour deformity	Natural contour
Inframammary fold	Not identified	Poorly identified	Marked displacement	Mild displacement	Excellent position
Scar	Poor hypertrophic scat	Poor scar (wide,, colour mismatch, hyperpigmented)	Fair scar (depressed, wide, colour mismatch)	Good scar (thin, mild colour mismatch)	Excellent scar (thin, good colour match)
Overall appearance	Unacceptable	Poor	Good	Very good	Excellent

sternal notch to nipple distance (SN-N), and nipple to inframammary fold distance (N-IMF)[12] Additional markings were made in the upright position to identify scarred areas and IMF contractures to be addressed. The lateral edge of the latissimus dorsi and the tip of the scapula were also marked.

Skin paddles were designed transversely inline with the new IMF, with the anterior edge positioned 2cm medial to border of latissimus dorsi muscle, to capture perfusion from thoracodorsal artery descending branch perforators. Following incision at the site of new IMF markings and elevation of glandular tissue from the chest wall, dissection proceeded to release the breast from the 4th to 6th rib in pre-pectoral plane.[13] Bifurcation of thoracodorsal artery is usually located about 5.1cm from posterior axillary fold (range is 2.1-7.5cm) and 2.2 cm from lateral edge of lastissimus dorsi.[14,15]

Marked skin paddle incised and lateral border of lastissimus dorsi was identified and raised. On its deep surface, descending branch of thoracodorsal artery identified and dissected up to its origin, followed by vertical splitting of the latissimus dorsi muscle to harvest a 3-5cm strip of muscle around the Pedicle and leaving muscle bulk behind. This step is demonstrated in figure1. The flap was tunneled for transposition to breast lower pole. Chest wall defect was covered with the local tissue.

Figure 1: *Intraoperative view of muscle sparing lastissimus dorsi flap harvest , based on descending branch of thoracodorsal artery , including only 3cm muscle strip around the Pedicle while preserving rest of muscle in place .*

Results

A total of eighteen patients (equating to 26 breasts) were included in the study, with eight patients presenting bilateral IMF contractures and the remainder unilateral. Scald burns were the most common etiology (n=11), followed by flame burns (n=6) and one case of chemical burn, all occurring during the prepubertal period. The mean age at the time of operation was 17.5 years.

All patients exhibited IMF contracture, flattened lower poles, and breast mound deficiency, with five patients also presenting with severe anterior trunk scarring.

Reconstruction of the IMF was accomplished using the Pedicle muscle sparing latissimus dorsi (MSLD) flap in eight patients (13 breasts) and thick split-thickness skin grafts in the remaining ten patients (13 breasts). The average skin paddle sizes was ranging from 6-8cm in width and 14-24cm in length as mentioned in Demographic details are mentioned in table2.

Table 2: *Demographics*

Characteristics	Number of patients (n)
Total number of patients	18
Unilateral cases	10
Bilateral cases	8
Reconstruction with MSLD	8 (13 breasts)
Reconstruction with STSG	10 (13 breasts)
Etiology	
Scald	11
Flame	6
Chemical	1
Mean age	17.5±2.3 Y
Mean hospital stay	
MSLD	8.3±2.9
STSG	3.7±0.8

Satisfactory breast contour outcomes were achieved in all patients reconstructed with MSLD, characterized by a convex lower breast pole, increased projection, and reshaped IMF. In contrast, patients treated with thick split-thickness skin grafts demonstrated lower satisfaction rates and a higher incidence of contracture recurrence. 3.7±0.8. These are depicted in figure2.

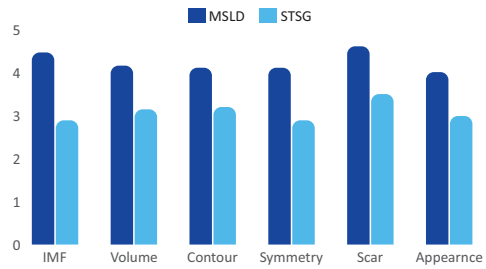

Figure 2: *Mean score for evaluated Inframammary fold deformaties, breast volume, contour, symmetry, breast scar and overall breast aesthetic appearance. The results were 4.4 vs 2.9 for Inframammary fold definition, 4.1 vs 3.9 for breast volume,4.1 vs 3.2 for contour, 4.1 vs 3.3 for breast symmetry, 4.6 vs 3.5 for breast scar and 4.0 vs 3.0 for overall breast aesthetic appearance.*

No seroma formation was observed at any MSLD flap donor site. Latissimus dorsi function was preserved in all patients, as evidenced by shoulder girdle active range of movement and muscle power.

Minor complications included distal tip necrosis, occurred in one patient (2 breasts) and wound dehiscence in one, both were managed conservatively. No instances of contracture recurrence were observed in any patient reconstructed with muscle sparing lastissimus dorsi flap, however contracture recurrence was noted in two patients having 3rd and 4th degree flame burn with severe anterior trunk scaring, reconstructed with STSG.

The association between donor site, pigmentation and pliability at three months follow up for graft vs flap was significant ($p<0.05$). Compared with MSLD, patients reconstructed with STSG were less satisfied with donor site scar. (Table 3) . However there was no significant difference between two patients group with respect to donor site scar vascularity and height representative patients of MSLD group are shown in figure 3 & 4 and representative patient of the group treated with STSG is shown in figure 5.

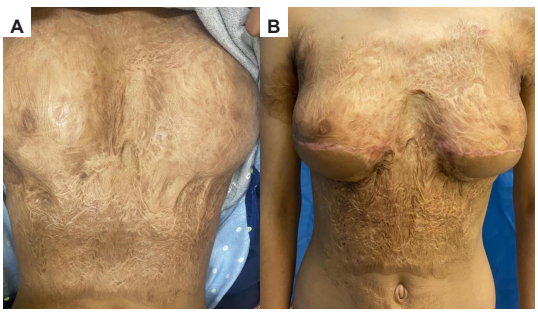

Figure 3: *A 15-years old female presented with bilateral post-burn breast projection deformity with NAC distortion, IMF contracture and lower pole flattening. (a) Contracture release and breast reconstruction was done with bilateral MSLD flap.The follow up results at 3 months shows well defined IMF and rectification of projection deformity symmetrically (b).*

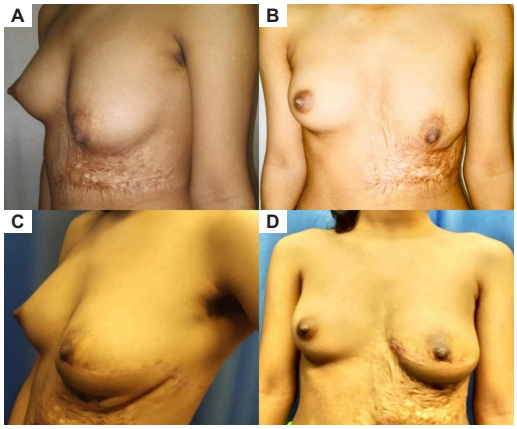

Figure 4: *A 17 years old female presented with post-burn breast deformity having IMF contracture and breast mound deficiency on left side(a) pro-op oblique (b) pre op frontal view. IMF contracture release and breast reconstruction was done with MSLD flap. Follow up results shown at three months , with well defined IMF , convex lower pole and adequate projection. (c) post-op oblique and (d) post-op frontal.*

Figure 5: *A 24-years old female with post scald burn bilateral breast deformity. Reconstruction was done with split thickness skin graft bilaterally. Pre operative view (a), one week flap (b), 3 month flap (c)*

Table 3: *Mean score with different aspects of the Vancouver scar scale.*

Scores	MSLD	STSG	p-value
Pigmentation	0.3 ± 0.7	1.53 ± 0.87	0.001
Pliability	0.38 ± 0.6	1.84 ± 1.62	0.008
Vascularity	0.07 ±0.2	0.15 ± 0.3	0.55
Scar height	0.07 ± 0.27	0.8 ± 0.9	0.17

Discussion:

Burn injuries, particularly in childhood, present a significant concern, ranking as the fifth most prevalent non-fatal injuries among children.[16] The trunk emerges as the third most affected body area, with breast involvement being a common occurrence.[17] Despite a global reduction in childhood burn mortality rates, there's been a notable uptick in patients seeking breast reconstruction to address post-burn deformities. Post burn deformities can either be linked to skin envelope or underlying glandular tissue. With varying degree of severity, it includes underdeveloped breast due to rigid scarring, inframammary fold contracture, altered skin texture, reduced projection, displaced or hypo-plastic nipple areola complex.[18] Unilateral deformity results in significant asymmetry. Post burn deformity can be associated with pain and significant social stigma, psychosocial effects of asymmetry in case of unilateral burn deformity and inability to lactate due to obliterated lactiferous ducts.[19]

Post-burn breast reconstruction encompasses a spectrum of reconstructive techniques, each tailored to address the unique challenges posed by the non-pliable, burnt tissue envelope. The reconstructive goals encompass

a multifaceted approach, including scar tissue release, restoration of breast volume, repositioning of the nipple-areolar complex (NAC), correction of breast mound deficiencies and rectification of projection deformities by releasing Inframammary fold (IMF) contracture. Reconstruction should be done at an age at which normal breast development would have been complete, may be years or decades after in initial injury.[20]

Central to achieving optimal breast contour is the intricate three-dimensional topography, heavily influenced by the lower breast pole, which imparts its characteristic convex shape and slight ptosis. Inframammary fold contracture has predominant effect on lower pole development leading to projection deformity. Hence, meticulous attention to lower pole reconstruction and inframammary fold (IMF) release assumes paramount importance in ensuring favorable aesthetic outcomes. The primary technique historically employed for post-burn breast reconstruction involves inframammary scar tissue release coupled with thick split-thickness or full-thickness skin grafting, or grafting along with the artificial dermal matrix.[21] However, skin graft either thickness split thickness or full thickness, have inferior graft take on lower breast pole, also associated with inferior aesthetic reconstruction and risk of hypertrophic scarring and contracture recurrence. Another option is to release scar and reconstruct the resulting defect on chest wall with skin graft but it also results in contour deformity.

However, alternative approaches such as z-plasty, local flap procedures, or tissue expansion have been explored, albeit with varying degrees of success and associated drawbacks, including contracture recurrence and sub-optimal aesthetic results, and risk of hypertrophic scarring.[22]

Patients with extensive abdominal scarring and Younger patients lacking abdominal laxity pose a challenge for pedicle abdominal flap procedures like the transverse rectus abdominis musculocutaneous (TRAM) flap or deep inferior epigastric artery flap from abdomen.[6] Consequently, the latissimus dorsi (LD) flap emerges as a versatile option, although not without drawbacks, including postoperative morbidity, hindrance in daily activities, surgical site seroma, and contour defects on back.

In 2003, Schwabegger et al. introduced the muscle sparring latissimus dorsi (MSLD) flap technique, aiming to preserve LD function while minimizing donor site morbidity and complications associated with thoracodorsal artery perforator flap.[8,23] Our study corroborates the efficacy of the MSLD flap in addressing IMF contracture and lower pole reconstruction, with superior aesthetic outcomes compared to split-thickness skin grafting. Horizontal or oblique skin paddle designs within natural creases ensure supple coverage and adequate perfusion from descending branch of thoracodorsal artery, thereby mitigating volume deficiencies and projection deformities with minimal risk of contracture recurrence in small to medium sized breasts , however supple tissue envelope is a limiting factor in large sized breasts.

The preservation of LD bulk and function, coupled with enhanced aesthetic outcomes, underscores the growing preference for the MSLD flap in post-burn breast reconstruction. Decreased donor site morbidity, minimal postoperative seroma formation and short hospital stay are added advantages.[24] While bilateral cases often achieve symmetrical results, unilateral burnt breast cases may necessitate additional symmetrizing procedures to optimize outcomes.

Limitations of this study involves lack of symmetrizing procedure to optimize aesthetic a outcome. Panel didn't scored best for aesthetic scale due to NAC size and position , extensive scarring in surrounding area of chest and abdomen, surrounding skin rigidity and reconstruction irregularities

Conclusion

In comparison to thick split-thickness skin grafts, the pedicled muscle-sparing latissimus dorsi flap offers itself as indispensable tool to the arsenal of reconstructive surgeon for post-burn breast reconstruction. This technique provides superior aesthetic results, minimizes the likelihood of contracture recurrence, and involves minimal functional compromise or donor site morbidity. However, split-thickness skin grafts remain a viable option for smaller breasts with simple contractures and less scarring.

Source of funding: None

Conflict of interest : None

Author's Contribution

Dr. Maria Ashraf: Conception and design of the study, Data collection, Data analysis and interpretation, Final approval of the version to be published and accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the

work are appropriately investigated and resolved.

Dr. Ammara Rabbani: Concept and design, substantial contribution to acquisition of data, critical review and final approval of the study.

Dr. Mehwish Ehsan: Concept and design, substantial contribution to acquisition of data, critical review and final approval of the study.

Dr. Kamran Khalid: substantial contribution to acquisition of data, Data analysis and interpretation and final approval of the version to be published

Dr. Yawwar Sajjad: acquisition of data, Data analysis and interpretation and final approval of the version to be published

Dr. Zain Ul Abidin: contribution to acquisition of data, Data analysis and interpretation and final approval of the version to be published

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