Egypt, J. Plast. Reconstr. Surg., Vol. 49, No. 1, January: 57-64, 2025

The Use of Muscle-Sparing Latissimus Dorsi Myocutaneous Flap (MSLD) to Minimize Functional Morbidity in Patients with Post Burn Breast Deformities

RAMA AHMED ALI, M.D.*; AHMED GAMAL HEMIDAN, M.Sc.**; DINA H. GAMAL EL-DIN, M.D.***; NANCY SHEHTA, M.D.**** and AYMAN NOAMAN, M.D.*

The Department of Plastic Surgery, Department of Radiology***, Department of Physiotherapy****, Faculty of Medicine, Cairo University and Department of Plastic Surgery**, Zayed Hospital, Cairo, Egypt*

Abstract

Background: The Latissimus dorsi (LD) flap plays a crucial role in breast reconstruction, particularly for post-mastectomy patients or those dealing with post-burn deformities. The pedicled LD emerges as a dependable option for restoring volume and in inframammary fold reconstruction in post-burn patients. Nevertheless, a comprehensive assessment of its potential long-term functional effects is imperative prior to opting for the pedicled LD in breast reconstruction.

Objective: This study aims to evaluate the functional outcomes and patient satisfaction in breast reconstruction using the (LD) flap versus the (MSLD) flap in post-burned patients.

Methodology: In this Ambidirectional Cohort Study (Combined retrospective and prospective cohort study), we enrolled twenty-four female patients who already underwent correction of post burn breast deformities to address post-burn breast deformities between 2020 and 2022. The included patients were divided into two groups; group I: (14 patients) with traditional latissimus dorsi LD flap, group II (10 patients): Underwent MSLD flap. Patient satisfaction was assessed using the Breast Q questionnaire, we also used the Western Ontario Shoulder Instability Index (WOSI) to evaluate shoulder function scores, and the functional assessment involved both objective measures, such as geometric measurements of shoulder range of movement and radiological assessment of the acromion-humeral interval (AHI).

Results: Concerning the Breast Q and WOSI results, there was statistically significant greater satisfaction in the MSLD flap group. As regarding the deficit in the range of shoulder movement and the AHI measurements, no statistically significant differences were observed between both groups, however, the MSLD flap group exhibited superior results.

Conclusion: For post-burn breast reconstruction, MSLD should be preferred, especially for younger patients. If MSLD is impractical, traditional LD is an acceptable alternative but with shoulder limitations lasting up to 6 months post-surgery. Preoperative imaging to identify abnormal AHI, thus, preventing shoulder impingement and initiating early postoperative shoulder exercises would help to achieve better outcomes.

Key Words: *Latissimus dorsi – Breast, reconstruction – Functional.*

Disclosure: No disclosure.

Ethical Committee: This work was approved by the ethical committee of our institute. Number; P.T.REC/012/004616.

Correspondence to: Dr. Rama Ahmed Ali, E-Mail: ramaahmed163@gmail.com

Introduction

The female breast is widely recognized as one of the most aesthetic features of the body. Regrettably, deep partial-thickness and full-thickness skin burns nearly always lead to deformities and disfigurement of this exquisite feminine characteristic **[1]**.

Various modalities have been devised to address contracted and aesthetically unpleasant burned breasts. These include skin grafts, Z-plasty, skin flaps, and other treatments such as the use of tissue expanders and prosthetic implants. Among the initial and, over time, most prevalent flaps employed in correction of asymmetrical breast volume and/or Inframammary fold reconstruction is the Latissimus Dorsi flap (LD). While the myocutaneous Latissimus Dorsi (LD) flap sufficed to replace breast volume in patients with smaller breasts, those with larger breasts often required a prosthetic implant to meet the necessary volume, prompting the exploration of various techniques to enhance flap volume and reduce reliance on implants **[2]**. In 1983, Hokin et al., introduced the initial extended version of the Latissimus Dorsi flap, incorporating lumbar fat into the flap. Subsequent variations extended its scope to include scapular and para-scapular fat **[3]**.

These flaps were associated with various donor site morbidities, in form of both aesthetic morbidities of donor site for e.g. scarring and back asymmetry as well as functional morbidities associated with the loss of function of the muscle with weak extension and abduction of the arm [3]. In response to this challenge, a refined variation emerged, described by Saint et al., in 2009 as the muscle-sparing latissimus dorsi (MSLD) flap, also known as the Thoraco-dorsal Artery Perforator flap (TDAP). Given that the Latissimus Dorsi (LD) flap's blood supply is segmental and sourced from both the descending and transverse branches of the thoracodorsal artery, this technique enables the harvesting of only a portion of the muscle, contingent on the descending branch [3,4].

While functional impairment following latissimus dorsi harvest is anticipated to be minimal in the (MSLD) flap compared to the (LD) flap, this aspect remains largely unexplored in the literature, particularly in post-burned patients whom are usually younger with longer life expectancy when compared to the post-mastectomy patients. Therefore, this study aims to evaluate the functional outcomes and patient satisfaction in breast reconstruction using the (LD) flap versus the (MSLD) flap in post-burned patients.

Methodology

This Ambidirectional Cohort Study aims to investigate the long-term functional sequalae and patient satisfaction in patients with post-burn breast deformity corrected using the Myocutaneous LD flap and the MSLD flap. The pedicled flap was employed for reconstructing the lower pole, inframammary fold, and addressing volume loss resulting from old deep thermal burns to the breast. All of the patients presented to us complaining of a breast mal-development as a sequelae of a thermal deep 2nd-degree or 3rd-degree burns during childhood period.

Breast deformity was corrected at least 1 year after completion of the breast development of the contralateral breast. All patients enrolled in this study were compliant for at least 12 months with follow-up dates and physiotherapy routines after the procedure. Exclusions were made for patients with a history of previous shoulder trauma or instability, as well as those with limitations in shoulder movement due to scarring, adhesions, or stiffness. Additionally, patients under 18 years old were excluded due to the expected incomplete union of the acromial apophysis at this age (such as illustrated in Fig. 1). Also, any patient didn't follow our basic physiotherapy program or wasn't compliant with our regular follow-ups were considered drop out subjects.

The data collection for each participant in this study encompasses key parameters, including age, date of surgery, hand dominance, site of the affected breast, preoperative shoulder range of motion (ROM), and comprehensive details of the surgical techniques previously used in correcting the breast deformity in this patient, and patients were distributed accordingly into groups I and II, patients who underwent myocutaneous LD flap were assigned to Group I and patients who underwent MSLD flap were assigned to group II. To ensure a thorough evaluation of long-term results, a combination of objective and subjective methods was utilized for the detection of shoulder dysfunction.

The operative techniques were as follows: LD flap group: The entire muscle with a skin paddle was islanded based on the main thoracodorsal vessels with preservation of the thoracodorsal nerve. MSLD flap group: Only a strip of the muscle was harvested, preserving the remaining parts. The strip was islanded based on the descending branch of the thoracodorsal vessels while preserving the thoracodorsal nerve.

Post-operatively, all study participants adhered to the basic physiotherapy program for LD flap harvest. This involved initiating passive flexion and abduction exercises on the first post-operative day, followed by active shoulder exercises and scapular exercises. Progressive exercises commenced by the 3rd week. Patients received written handouts and instructions for performing these exercises at home. Regular weekly follow-ups with the physiotherapist were scheduled for a minimum of 3 months post-operatively.

I- *Clinical assessment:* Any patients with flap morbidities, severe complication (e.g. total flap loss) or cosmetic dis-satisfaction were excluded. All patients were presented after the final stage of correction of their deformities and IMF reconstruction. Any patient who in need of another stage of correction of the breast deformities were not included. Then evaluation includes measuring the range of shoulder joint movement on the treated side, comparing it with pre-operative range obtained from medical records. A goniometer measures angles for active and passive flexion, extension, adduction, abduction, external rotation, and internal rotation of the arm at the shoulder joint.

II- *Radiological assessment:* A bilateral plain shoulder X-ray in anteroposterior view is performed. The acromion-humeral interval (AHI), the shortest distance between the acromion and humeral articular surface, is measured in centimeters and recorded for both treated and control sides.

III- *Western Ontario Shoulder Instability Index (WOSI):* This index assesses four domains: Physical function, sports/recreation/work, lifestyle, and emotional well-being. Each domain includes 21 questions, and the patient assigns a score between 0 and 100 facilitated by visual analogue. The summation of the domains is collected and compared, where 0 indicates no affection, and 100 indicates extreme affection [5].

IV- *Breast-Q:* Satisfaction with breast deformity correction results was assessed using the Arabic version of Breast-Q Latissimus Dorsi module ver. 2.0: Physical Well-Being: Back and Shoulder questionnaire, part of the reconstruction module, where the maximum possible score is 55 (indicating the worst outcome) and the minimum possible score is 11 (indicating the better patient satisfaction) [6].

V- *Statistical methods:*

"Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean, standard deviation, median, minimum and maximum. Comparisons between groups were done using unpaired *t*-test in normally distributed quantitative variables while non-parametric Mann-Whitney test was used for non-normally distributed quantitative variables. Comparison between paired data measured within same patient (pre and post) was done using paired *t*-test [7]. *p*-values less than 0.05 were considered as statistically significant".

Results

This retrospective study focused on patients with post-burn breast deformities treated with LD or MSLD flaps, ultimately comprising 27 participants. During the follow-up period, 3 patients were excluded as two of them wasn't compliant in the routine physiotherapy and follow-up dates and one patient refused to be included in our study and refused to fill the needed questionnaires. So, 24 patients were included in the final data assessment. Of these, 14 underwent LD flap, and 10 underwent MSLD flap. Demographic data, encompassing patients' occupations, dominant hand, and the side of breast reconstruction, were recorded (Table 1). No statistically significant differences were observed between the two groups in terms of age, occupation, dominant hand, and the side of the operation (p>0.05). The mean follow-up period in the MSLD group is 30 months, and the mean follow-up period in the LD group is 20.85 months.

Range of movement of shoulder joint (ROM):

The difference in active and passive range was assessed and compared between the two groups. The deficit in active and passive adduction was greater in the LD group (-12.86 and -12.14 degrees) compared to the MSLD group (-9.00 and -7.00 degrees), but the difference was not statistically significant. The mean change in active and passive internal rotation was (-15.71 and -12.14) degrees in the LD group versus (-5.00 and -1.00) degrees in the MSLD group. The change in active and passive extension was (-4.29 and -3.57) degrees in the LD group versus (-6.00 and -6.00) degrees in the MSLD group. These results are illustrated in (Table 2).

Acromio-Humeral interval (AHI):

The mean distance in the LD group was 1.41 cm on the non-operated side versus 1.27cm on the treated side. The difference between both sides was statistically significant. Concerning the AHI in the MSLD group, the mean interval was 1.29cm on the non-operated side versus 1.20cm on the treated side, with the difference being statistically significant. However, when comparing the difference in AHI between both groups, mean values of 0.13 cm in the LD group and 0.08 cm in the MSLD group were found to be statistically not significant. (Tables 3,4) (Figs. 2,3).

Table (1): Basic characteristics of the studied group (n=24).

Characteristic	LD technique group (n=14)	MSLD technique group (n=10)	Test (*t*)	*p*-value
Age/years:				
Mean ± SD	18.79±2.39	19.20±2.09	-0.440	0.664
Follow-up period:				
Mean ± SD in Months	30.00±7.58	20.85±5.93		
Category			X^2	*p*-value
Occupation:				
Employer:				
N	3	4	2.057	0.151
%	21.4 %	40.0%		
Student:				
N	11	6		
%	78.5 %	60.0%		
Dominant hand:				
Left:				
N	0	2	3.055	0.081
%	0.0%	20.0%		
Right:				
N	14	8		
%	100.0%	80.0%		
Side of operation:				
Left:				
N	6	2	1.371	0.242
%	42.9%	20.0%		
Right:				
N	8	8		
%	57.1%	80.0%		

(*t*): Independent Samples Test. (X^2): Chi-Square Tests.

WOSI:

The mean value of the physical domain score was 179.29/1000 in the LD group versus 30/1000 in the MSLD group, which was statistically significant (*p*-value 0.019). Similarly, the mean score of the sport domain was 132.86/400 in the LD group compared to 32/400 in the MSLD group, also showing statistical significance (*p*-value 0.009). However, for the lifestyle and emotion scores, the difference was not statistically significant. (Table 5).

Breast Q:

The mean score of the BREAST-Q in the LD group was 22.14 compared to 13.80 in the MSLD group. The main difference was in the questions addressing the functional outcome rather than the aesthetic donor site morbidities. The difference was statistically significant with a *p*-value of 0.019, favoring the MSLD group. These results are illustrated in Table (6) and Fig. (4).

Table (2): Shows the difference in the shoulder movements pre versus post operative in both groups.

	LD					MSLD					*p*-value
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	
Active adduction change	-12.86	12.67	-5.00	-40.00	-5.00	-9.00	2.11	-10.00	-10.00	-5.00	0.585
Passive adduction change	-12.14	12.67	-10.00	-40.00	0.00	-7.00	6.32	-10.00	-15.00	0.00	0.508
Active extension change	-4.29	7.03	0.00	-20.00	0.00	-6.00	8.43	-5.00	-15.00	5.00	0.752
Passive extension change	-3.57	7.19	0.00	-20.00	0.00	-6.00	6.15	-5.00	-15.00	0.00	0.259
Active internal rotation change	-15.71	17.63	-10.00	-40.00	5.00	-5.00	8.82	0.00	-15.00	5.00	0.172
Passive internal rotation change	-12.14	12.97	-10.00	-30.00	0.00	-1.00	11.25	0.00	-15.00	15.00	0.064

Table (3): The AHI between the treated side and the control side in both groups.

	LD						MSLD					
	Mean	SD	Median	Min	Max	*p*-value	Mean	SD	Median	Min	Max	*p*-value
Control AHI	1.41	0.14	1.44	1.13	1.56	<0.001	1.29	0.11	1.25	1.20	1.48	0.006
Treated AHI	1.27	0.15	1.27	1.01	1.50		1.21	0.10	1.20	1.08	1.34	

Table (4): The difference between AHI in both groups.

	LD					MSLD					*p*-value
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	
Difference in AHI	0.13	0.069	0.13	0.04	0.24	0.08	0.073	0.05	0.00	0.17	0.10

Table (5): The WOSI score in both groups the LD versus MSLD group.

	LD					MSLD					*p*-value
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	
Total physical score	179.29	111.30	230.00	0.00	285.00	30.00	20.00	30.00	10.00	60.00	0.019
Total sport score	132.86	116.46	150.00	0.00	360.00	32.00	43.41	0.00	0.00	100.00	0.009
Total life style score	79.29	57.81	120.00	0.00	140.00	44.00	27.16	50.00	0.00	80.00	0.212
Total emotion score	58.57	69.38	20.00	0.00	180.00	22.00	20.44	30.00	0.00	50.00	0.508

Table (6): Breast Q score in LD versus MSLD group.

	LD					MSLD					*p*-value
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	
Total Breast Q	22.14	9.32	16.00	11.00	33.00	13.80	2.94	13.00	11.00	19.00	0.019

Fig. (1): Incomplete union of the acromial apophysis in noted, hindering the radiological assessment of the AHI and hence excluding this patient.

Fig. (2): Right side the operated side post LD flap reconstruction; The AHI is 0.98 cm, versus 1.06 cm in control (non-operated) left side.

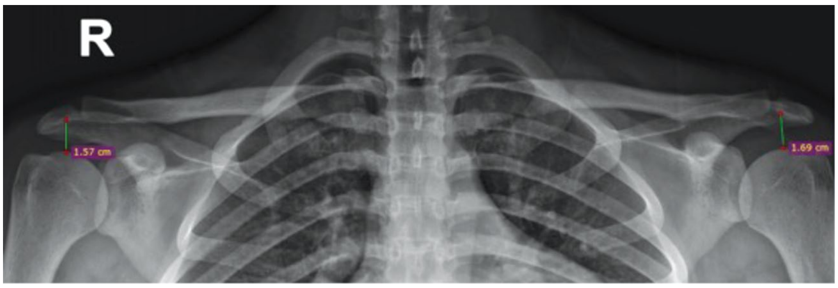

Fig. (3): Right side the operated side post MSLD flap reconstruction; The AHI is 1.57 cm, versus 1.69 cm in control (non-operated) left side.

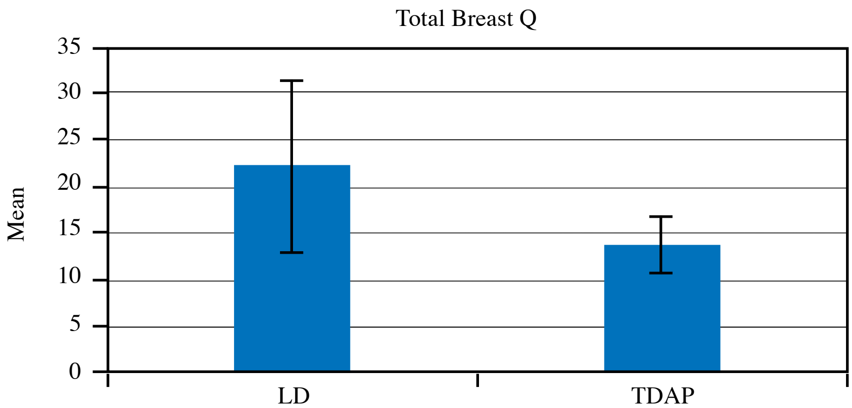

Fig. (4): The mean score of the breast Q in LD group versus MSLD group.

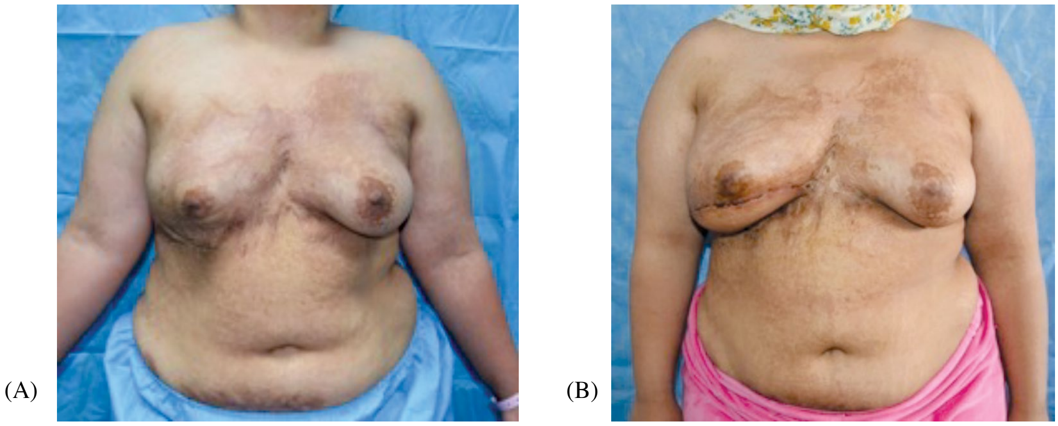

Fig. (5): Patient with post-burn deformity of right breast; (A) Loss of the lower pole volume and obliterated IMF. (B) Post MSLD flap for volume replacement and IMF reconstruction.

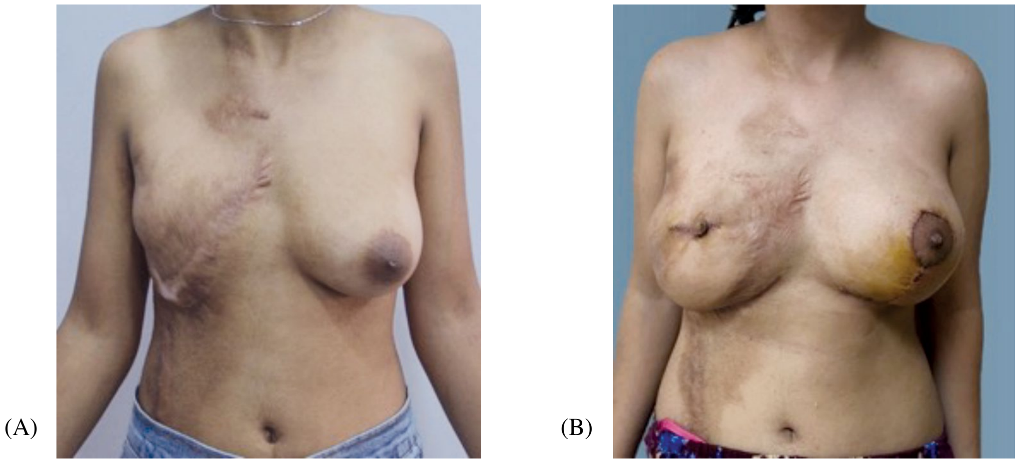

Fig. (6): Patient with post-burn deformity of right breast; (A) Loss of the lower pole volume and obliterated IMF. (B) Post LD flap for volume replacement and IMF reconstruction. Followed by nipple reconstruction and contralateral symmetrization.

Discussion

Breast deformities that affect female patients who have survived burn injuries span a broad spectrum, ranging from unsightly scarring up to affection of breast volume. Breast shape deformities typically occur in patients who experienced breast burn during the preadolescent phase. Volume affection is often a sequel to a tight skin envelope that hinders normal breast development. Additionally, there is a need for reconstruction of the inframammary fold (IMF). In patients requiring volume restoration and/or inframammary fold (IMF) reconstruction, flap-based reconstruction is essential. The latissimus dorsi flap is one of the most common flaps used in post-burn breast reconstruction **[2]**.

While many articles have discussed the functional sequelae in post-mastectomy breast reconstruction, this is one of the very few articles addressing this issue in post-burn breast reconstruction. As patients with post-burn deformities are typically in a younger age group with a longer life expectancy when compared to post-mastectomy patients. So, addressing the functional sequel is crucial in such patients **[8]**.

The functional impact of harvesting the latissimus dorsi muscle can be assessed through objective and subjective methods. The objective method involves assessing the range of shoulder joint movement, especially the actions performed by the latissimus dorsi. Additionally, subjective assessment can be conducted through questionnaires answered by the patients.

Many authors have explored the functional sequelae following various types of (LD) flap procedures, including traditional LD, extended LD, or (MSLD). The majority of these studies have been conducted in the context of post-mastectomy breast reconstruction. While a few studies have examined LD muscle transfer for other indications, such as lower limb and head and neck reconstruction, none have specifically focused on post-burn breast reconstruction.

For the abovementioned reasons, we decided to focus on comparing the functional sequalae of both LD and MSLD flaps and their impact on patient's daily live activities.

Spear et al., examined biomechanical changes following latissimus dorsi (LD) harvesting. They noted potential early post operative limited shoulder joint range of motion in patients, but the majority typically regain full range within the second to third week postoperatively. However, complete takeover of the extension and adduction function by the teres major muscle may extend over a period of 6 to 12 months [8].

In a study by Kim et al., they addressed the limitation of shoulder joint movement in post mastectomy patients who underwent muscle-sparing latissimus dorsi (MSLD) versus extended LD flap procedures. Their findings revealed a 7.5-fold increase in shoulder joint limitation of movement in the extended LD group compared to MSLD. Additionally, back asymmetry occurred less frequently in the MSLD group [9].

Glassy et al., investigated the time scale required for the recovery and restoration of strength in the (LD) muscle by examining shoulder motion range, shoulder strength, pain scale, and Disabilities of the Arm, Shoulder, and Hand (DASH) score at 6 weeks, 6 months, and 1-year post-operation. Their findings revealed an initial loss in the majority of range of motion at 6 weeks postoperative, with a gradual improvement observed until the end of the year. Strength, DASH score, and pain scales demonstrated improvement and normalization by the end of the year. Notably, patients with extended LD flaps exhibited less favorable scores and recovery outcomes compared to those with traditional LD flaps [10].

The (DASH) score was utilized to evaluate 18 patients who underwent (LD) flap reconstruction following various pathologies, including breast, head and neck, and lower limb reconstruction. A majority of the patients experienced moderate disability. Those significantly affected included individuals with marked disability after bilateral muscle harvest and athletes struggling to return to their pre-operative fitness levels. Therefore, the authors recommend thorough counseling for patients undergoing bilateral reconstruction and those involved in sports, highlighting potential postoperative muscle harvest complications. Additionally, they suggest considering the use of perforator-based flaps when applicable for these specific patient groups [11].

Objective assessment through isokinetic testing of muscle function was conducted at 3- and 6-months post-muscle transfer, with a focus on adduction, abduction, internal, and external rotation. The results revealed notable weakness, particularly in adduction (33±9%) and internal rotation (16±11%). Consequently, the recommendation is to incorporate shoulder strengthening exercises, particularly targeting adduction and internal rotation, following latissimus dorsi transfer [12].

Hamdi et al., investigated the morbidity associated with harvesting thoracodorsal-based flaps in patients undergoing partial breast reconstruction. A comparative analysis was conducted between the operated side and the contralateral non-operated side, focusing on shoulder mobility, muscle strength, and thickness. The range of motion was statistically comparable to the control side in most of the movements. However, a significant reduction was observed in passive forward elevation and passive abduction on the operated side compared to the control side. Notably, the thickness of the muscle remained unaffected after surgery [13].

In this study, functional impairment was assessed objectively by measuring the range of shoulder motion one year post-operatively, with the results expressed in degrees and compared to pre-operative values. The deficit in both active and passive adduction was greater in the LD group (-12.86 and -12.14 degrees) compared to the MSLD group (-9.00 and -7.00 degrees), though the difference was not statistically significant. The mean change in active and passive internal rotation was greater in the LD group (-15.71 and -12.14 degrees) compared to the MSLD group (-5.00 and -1.00 degrees). Similarly, the change in active and passive extension was higher in the LD group (-4.29 and -3.57 degrees) compared to the MSLD group (-6.00 and -6.00 degrees).

In terms of radiological assessment, both groups showed a decrease in AHI compared to the control side. In the LD group, the mean interval was 1.41 cm on the non-operated side versus 1.27cm on the treated side, with a statistically significant difference. In the MSLD group, the mean distance was 1.29cm on the non-operated side versus 1.20cm on the treated side, also showing a statistically significant difference. Although the post-operative decrease in distance was observed, it remained above the critical value indicating a risk of shoulder instability [14].

The subjective assessment was conducted using two questionnaires. The first one was the WOSI score, which evaluates four domains. In the LD group, the physical domain score was 179.29/1000, significantly higher than the MSLD group's score of 30/1000 (p-value 0.019). Similarly, the mean score for the sport domain was 132.86/400 in the LD group compared to 32/400 in the MSLD group, demonstrating statistical significance (p-value 0.009). However, for the lifestyle and emotion scores, the difference was not statistically significant.

The second questionnaire utilized was the Breast Q score Latissimus Dorsi module, and the results showed statistical significance in favor of the MSLD group (Mean values were 22.14 for LD and 13.80 for MSLD).

The limitations of our study is lack of preoperative radiological assessment which would be beneficial for the patient selection to exclude any at-risk patients of postoperative shoulder and muscle affection. Also, preoperative Breast q was not obtained for better comparison. And even though our study includes 24 patients which can be considered a small number and further study on larger group of these patients will be beneficial to help in future selection of the flap with minimal long term functional affection. a high number of burn patients who need breast reconstruction -which is not that common presentation in our institutes-, we believe that even though the difference is minimal, it is still considered as a better result.

Conclusion:

As shown from our results, we believe that in patients with post-burn breast deformities who seek breast reconstruction, MSLD would be a better alternative to traditional LD flap, especially given that many of them belong to a younger age group with a longer life expectancy. In cases where MSLD is not feasible due to technical issues or the need for a traditional LD to enhance flap volume, we suggest counseling patients about potential limitations in shoulder movement during the early postoperative period, up to 6 months post-operation. Also, to help prevent potential postoperative shoulder impingement, we suggest conducting preoperative imaging to identify patients with abnormal AHI. Additionally, initiating early postoperative shoulder strengthening exercises is advisable.

References

1- MacLennan S.E., Wells M.D. and Neale HW.: Reconstruction of the burned breast. Clin. Plast. Surg., 27 (1): 113-119, 2000.

2- Ozgur F., Gokalan I., Mavili E., Erk Y. and Kecik A.: Reconstruction of postburn breast deformities. Burns, 18 (6): 504-509, 1992. doi:https://doi.org/10.1016/0305-4179(92)90186-X.

3- Clough K.B., Louis-Sylvestre C., Fitoussi A., Couturaud B. and Nos C.: Donor Site Sequelae after Autologous Breast Reconstruction with an Extended Latissimus Dorsi Flap. Plast Reconstr Surg., 109 (6), 2002. https://journals.lww.com/plasreconsurg/fulltext/2002/05000/donor_site_sequelae_after_autologous_breast.20.aspx.

4- Saint-Cyr M., Nagarkar P., Schaverien M., Dauwe P., Wong C. and Rohrich R.J.: The pedicled descending branch muscle-sparing latissimus dorsi flap for breast reconstruction. Plast. Reconstr. Surg., 123 (1): 13-24, 2009. doi:10.1097/PRS.0b013e3181934838.

5- Salomonsson B., Ahlström S., Dalén N. and Lillkrona U.: The Western Ontario Shoulder Instability Index (WOSI): Validity, reliability, and responsiveness retested with a Swedish translation. Acta. Orthop., 80 (2): 233-238, 2009. doi:10.3109/17453670902930057.

6- Liu L.Q., Branford O.A. and Mehigan S.: BREAST-Q measurement of the patient perspective in oncoplastic breast surgery: A systematic review. Plast Reconstr Surg - Glob Open., 6 (8): 1-8, 2018. doi:10.1097/GOX.0000000000001904.

7- CHAN Y.H.: Biostatistics 102: quantitative data--parametric & non-parametric tests. Singapore Med. J., 44 (8): 391-396, 2003.

8- Spear S.L. and Hess C.L.: A review of the biomechanical and functional changes in the shoulder following transfer of the latissimus dorsi muscles. Plast. Reconstr. Surg., 115 (7): 2070-2073, 2005. doi:10.1097/01.PRS.0000163329.96736.6A.

9- Kim H., Wiraatmadja E.S., Lim S.Y., et al.: Comparison of morbidity of donor site following pedicled muscle-sparing latissimus dorsi flap versus extended latissimus dorsi flap breast reconstruction. J. Plast. Reconstr. Aesthetic Surg., 66 (5): 640-646, 2013. doi:10.1016/j.bjps.2013.01.026.

10- Glassey N., Perks G.B. and McCulley S.J.: A prospective assessment of shoulder morbidity and recovery time scales following latissimus dorsi breast reconstruction. Plast. Reconstr Surg., 122 (5): 1334-1340, 2008. doi:10.1097/PRS.0b013e3181881ffe.

11- Koh C.E. and Morrison W.A.: Functional impairment after latissimus dorsi flap. ANZ J. Surg., 79 (1-2): 42-47, 2009. doi:10.1111/j.1445-2197.2008.04797.x.

12- Forthomme B., Heymans O., Jacquemin D., et al.: Shoulder function after latissimus dorsi transfer in breast reconstruction. Clin. Physiol. Funct Imaging, 30 (6): 406-412, 2010. doi:10.1111/j.1475-097X.2010.00956.x.

13- Hamdi M., Decorte T., Demuynck M., et al.: Shoulder function after harvesting a thoracodorsal artery perforator flap. Plast. Reconstr. Surg., 122 (4): 1111-1117, 2008. doi:10.1097/PRS.0b013e31818459b4.

14- Goutallier D., Le Guilloux P., Postel J.M., Radier C., Bernageau J. and Zilber S.: Acromio humeral distance less than six millimeter: Its meaning in full-thickness rotator cuff tear. Orthop. Traumatol. Surg. Res., 97 (3): 246-251, 2011. doi:10.1016/j.otsr.2011.01.010.