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Volume Change of Muscle and Fat Portions of Latissimus Dorsi Myocutaneous Flap after Breast Reconstruction

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Background: Myocutaneous flaps are composed of muscle and fat portions, and exhibit volume changes with time. However, no consideration is generally given to volume changes of muscle and fat portions occurring in the flap. Therefore, we conducted this study to analyze the volume changes of muscle and fat portions of pedicled latissimus dorsi myocutaneous flaps over time.

Methods: Sixteen patients who underwent breast reconstruction using a latissimus dorsi myocutaneous flap between 2009 and 2017 were enrolled in this study. Using their postoperative computed tomography scan data, we measured the volume of muscle and fat portions of the flap, and performed a statistical analysis of volume changes over time. We also measured the volume of latissimus dorsi muscle on the opposite side and compared the difference in muscle volume.

Results: The volume of the muscle portion of latissimus dorsi myocutaneous flap decreased by approximately 24%, from 6 months to postoperative year 2; from the third year, it shrank with a decrease rate similar to that of normal muscle. The fat portion of the flap showed no regular volume changes.

Conclusions: Atrophy of the muscle portion is the primary cause of volume change of latissimus dorsi myocutaneous flaps over time. it is necessary to understand the difference in the volume change patterns of the muscle and fat. To maintain a long-term satisfactory result, it is better to make the maximum possible use of the relatively stable fat portion rather than the muscle portion. *(Plast Reconstr Surg Glob Open 2021;9:e3536; doi: 10.1097/GOX.0000000000003536; Published online 15 April 2021.)*

INTRODUCTION

Pedicled latissimus dorsi myocutaneous flaps (pLDMCFs) are useful in breast reconstruction after partial mastectomy for patients with breast cancer. These myocutaneous flaps are composed of muscle and fat portions, and exhibit volume changes with time, which has a significant effect on the long-term results after breast reconstruction is performed using pLDMCFs.[1,2] Although breast reconstruction is successful with the pLDMCF, the flap could shrink, and the reconstructed breast can undergo changes over time from the immediate postoperative state. Therefore, it is important to determine the volume of the flap that could decrease over time. In addition, the factors involved in the volume change of muscle and fat are different, which therefore necessitates an understanding of the volume change pattern of each portion for designing the flap. Although previous studies have investigated the volume changes in myocutaneous flaps, they did not distinguish between muscle and fat portions or had analyzed only the volume change of muscle.[3–6]

Therefore, this study was conducted to evaluate the objective volume change of the muscle and fat portions of pLDMCFs over time in breast reconstruction, using computed tomography (CT). Moreover, to understand the volume change of the muscle portion, we measured the volume of the opposite normal latissimus dorsi muscle

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and compared the change with the volume change of the muscle portion of pLDMCF.

MATERIALS AND METHODS

Patient Characteristics

From October 2009 to November 2017, a total of 26 patients underwent breast reconstruction using pLDMCFs after partial mastectomy for breast cancer. Excluding 10 patients who were in the period of <1 year postoperatively or who had been lost to follow-up, the subjects included in this study were 16 patients who were followed up for more than 1 year after surgery. The pathological diagnosis; clinical stage; amount of resection of breast tissue; and history of chemotherapy, immunotherapy, and radiotherapy were investigated for each patient. Hematoma, seroma, infection, and fat necrosis were identified to examine possible complications caused as a result of surgery and radiotherapy.

Operation Methods and Postoperative Management

In all patients, the pLDMCFs were used for immediate reconstruction of the breast, which had been in the partial mastectomy (quadrantectomy or lumpectomy) or total mastectomy state for breast cancer, at the Department of General Surgery. Breast reconstruction using a pLDMCF was performed by a surgeon who had been a specialist in plastic and reconstructive surgery. The latissimus dorsi muscle was completely separated from its origin and insertion, while conserving the thoracodorsal nerve, in all patients. A subcutaneous tunnel was constructed below the axilla, and then the pLDMCF was moved to the defect area of the breast.

A drainage tube was placed in the donor site and the breast, and it was maintained until the amount of drainage became <20 ml/day. Prophylactic antibiotics were used during this period.

All patients except 1 received postoperative adjuvant radiotherapy from the first month postoperatively, with whole breast radiotherapy consisting of 45–50.4 Gy applied in 25–28 fractions (1.8–2.0 Gy per fraction). The entire ipsilateral breast and the chest wall were included in the irradiated volume. Patients were treated using 6-MV photon beams and tangential fields. After whole breast irradiation, boost irradiation was administered to the tumor bed due to a higher risk for recurrence. The boost doses administered to the tumor bed were ~10–16 Gy applied in 5–8 fractions using an anterior portal of 6-MeV electron or three-dimensional conformal radiotherapy of 6-MV photon beams. All dose schedules were administered 5 days/week.

Evaluation of Volume Decrease

CT images were used to evaluate the volume decrease of the flap. All patients underwent a CT scan routinely for oncologic screening at 6 months postoperatively, and then at 1-year intervals at the Department of General Surgery. No additional CT scanning or other investigation was performed for this study, so the patients had no additional costs to pay during this study.

The CT images were acquired at 5-mm intervals using a dual 128-channel CT scanner (SOMATOM Definition Flash; Siemens, Munich, Germany). The area of the flap in each CT image was calculated by drawing a line along the border of the muscle and fat portions of the LDMCF with the mouse, in the axial view, using the Infinitt software program. As a control group, the area of the contralateral latissimus dorsi muscle was also calculated for comparison with the volume decrease of normal muscle. (**See figure, Supplemental Digital Content 1,** which displays the method of calculating the area of muscle and fat portion of the flap and contralateral latissimus dorsi muscle. Both right and left images are at the same level of axial view of postoperatative CT scan. In right image, we draw a line along the border of the fat (yellow) and muscle (red) portions of latissimus dorsi myocutaneous flap and contralateral latissimus dorsi muscle (red), using the Infinitt software program. **http://links.lww.com/PRSGO/B629**.) Then, the volume was obtained by integrating each cross section. First, a CT examination was conducted at 6 months postoperatively, and hence we evaluated the amount of muscle and fat portion changes compared with those at 6 months postoperatively.

Furthermore, to compare the volume changes of the muscle portion with those of the normal muscle, we calculated the volume decrease rate and analyzed it statistically. We defined the period of 6 months to first year after surgery as t1, first year to second year after surgery as t2, second year to third year as t3, third year to four year as t4, and fourth year to fifth year as t5. In each period, the rate of volume decrease was evaluated in the following 3 groups; muscle portion and fat portion of the flap and the contralateral latissimus dorsi muscle. The mean volume decrease rate of the group in each period was defined as vd1–vd5.

Statistical analysis of data was performed using IBM SPSS, version 19.0 (IBM Corp., Armonk, N.Y.). The alterations in the volume decrease rate of the muscle and fat portions of the LDMCF and the contralateral latissimus dorsi muscle over time were compared using the generalized linear model. Furthermore, the 2-sample *t*-test was used to compare the volume decrease rate in the 3 groups at each time point. A statistical significance was accepted when $P < 0.05$.

RESULTS

All patients were diagnosed with intraductal carcinoma, except 1 patient who was diagnosed with phyllodes tumor. Five patients were in clinical stage I, 7 patients in stage IIA, 1 in stage IIB, 1 in stage IIIA, and 1 patient in stage IIIC. All patients, except 1, received postoperative chemotherapy and radiotherapy, whereas 7 patients received hormone therapy (Table 1).

Compared with 6 months postoperatively, the average volumes of the muscle portion of the LDMCF were 87.0% ± 2.8% at 1 year postoperatively, 76.0% ±7.6% at 2 years, 73.1% ± 9.0% at 3 years, 72.6% ± 10.1% at 4 years, and 71.1% ± 9.8% at 5 years. The average volumes of the fat portion of the LDMCF were 100.6% ± 1.0% at 1 year postoperatively, 100.3% ± 1.2% at 2 years, 97.9% ± 4.5% at 3 years, 97.2% ± 6.0% at 4 years, and 97.5% ± 5.1% at 5 years (Table 2 and Fig. 1).

Table 1. Patient Characteristics

Patient	Age	BMI	Pathological Finding	Clinical Stage	Breast Conserving Surgery	Amount of Resection (cm)	Chemotherapy	Hormonal Therapy	Radiation Therapy
1	45	17.69	IDC	IIA	Quadrantectomy	7.0 × 5.0 × 2.0	o	x	o
2	41	25.53	IDC	IIIC	Lumpectomy	9.7 × 5.0 × 3.0	o	x	o
3	42	20.55	IDC	I	Lumpectomy	7.0 × 6.5 × 2.0	o	x	o
4	34	24.26	IDC	I	Quadrantectomy	7.5 × 5.5 × 3.5	o	o	o
5	41	20.36	IDC	I	Quadrantectomy	10.5 × 8.0 × 3.0	o	x	o
6	57	21.93	IDC	IIB	Lumpectomy	7.5 × 6.0 × 3.0	o	x	o
7	41	22.50	IDC	IIA	Quadrantectomy	7.5 × 6.0 × 4.0	o	o	o
8	52	23.86	IDC	I	Lumpectomy	5.0 × 4.2 × 2.2	o	x	o
9	40	20.45	IDC	IIA	Lumpectomy	4.0 × 3.3 × 2.8	o	x	o
10	46	21.87	IDC	IIA	Quadrantectomy	9.0 × 7.0 × 3.5	o	o	o
11	56	21.78	IDC	I	Lumpectomy	6.7 × 6.5 × 3.5	o	x	o
12	47	20.94	IDC	IIIA	Quadrantectomy	7.5 × 7.0 × 4.0	o	o	o
13	37	23.83	Phyllodes tumor		Quadrantectomy	8.3 × 6.7 × 2.5	x	x	x
14	43	20.20	IDC	IIA	Mastectomy	14.0 × 10.5 × 2.3	o	o	o
15	45	23.24	IDC	IIA	Mastectomy	11.0 × 7.5 × 2.5	o	o	o
16	53	26.31	IDC	IIA	Lumpectomy	7.5 × 5.3 × 2.3	o	x	o

BMI, Body mass index; IDC, Intraductal carcinoma.

Table 2. Mean Volume Change of Fat and Muscle Portion of LDMCF between the Postoperative 6 Months and 5 Years

Group	Time, mean (%) ± SD					
	POD 0.5 year	POD 1 year	POD 2 years	POD 3 years	POD 4 years	POD 5 years
Muscle	100.0 ± 0.0	87.0 ± 2.8	76.0 ± 7.6	73.1 ± 9.0	72.6 ± 10.1	71.1 ± 9.8
Fat	100.0 ± 0.0	100.6 ± 1.0	100.3 ± 1.2	97.870 ± 4.5	97.2 ± 6.0	97.5 ± 5.1

The mean volume decrease rates of the muscle portion of the LDMCF were 13.0% ± 0.4% between 6 months and 1 year postoperatively (vd1), 11.4% ± 0.5% in t2 (vd2), 5.7% ± 0.5% in t3 (vd3), 2.8% ± 0.5% in t4 (vd4), and 2.3% ± 0.6% in t5 (vd5). The contralateral latissimus dorsi muscle demonstrated volume decrease rates of 2.0% ± 0.4% for vd1, 2.2% ± 0.5% for vd2, 2.0% ± 0.5% for vd3, 2.2% ± 0.5% for vd4, and 2.4% ± 0.6% for vd5. The rates of volume decrease of the fat portion of the LDMCF were –0.6% ± 0.4% for vd1, 0.2% ± 0.5% for vd2, 1.0% ± 0.5% for vd3, 0.2% ± 0.5% for vd4, and 0.0% ± 0.6% for vd5.

Results of comparison according to time showed that the rate of volume decrease in t2 (vd2) was statistically significantly higher than the rate of volume decrease in t3 (vd3). However, there was no statistically significant difference in volume decrease rates between vd1 and vd2. There was also no statistically significant difference in volume decrease rates among vd3, vd4, and vd5.

In the comparison between the groups, the volume reduction rate of the muscle portion was significantly higher than that of the contralateral LD muscle or fat portion of the LDMCF, but the difference between the rate of volume decrease in the contralateral LD muscle and fat portions of the LDMCF was not statistically significant. To summarize these results, the vd1 and vd2 of the muscle portion of the LDMCF were statistically significantly higher than those of the other groups, with no statistically significant differences between vd1 and vd2. However,

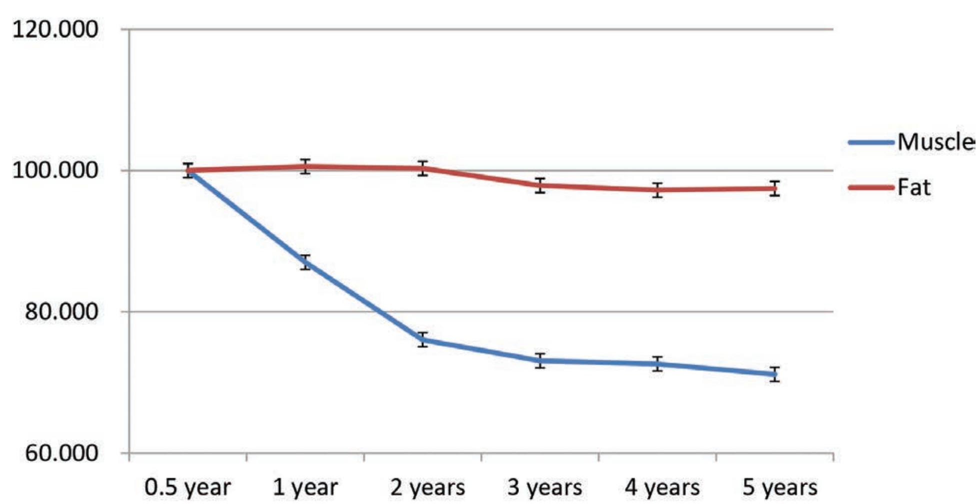

Fig. 1. Volume changes of fat (red line) and muscle (blue line) portions of the pedicled latissimus dorsi myocutaneous flap from 6 months to fifth year postoperatively.

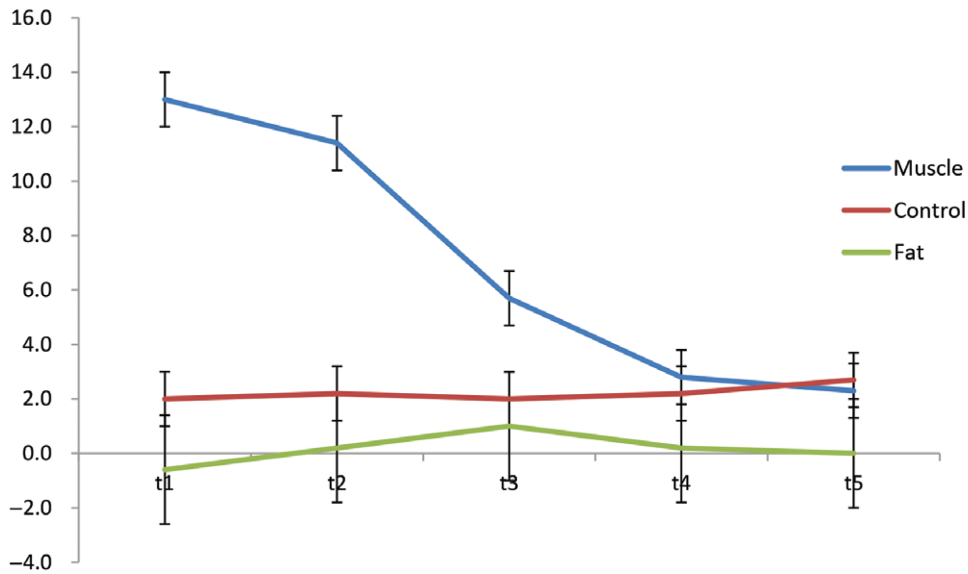

Fig. 2. Rate of volume change of the muscle (blue line) and fat (red line) portions of the pedicled latissimus dorsi myocutaneous flap and the contralateral latissimus dorsi muscle (green line) as a control group over postoperative time. Horizontal axis represents time. We defined the period of 6 months to first year after surgery as t1, first year to second year as t2, second year to third year as t3, third year to fourth year as t4, and fourth year to fifth year as t5. Vertical axis represents the mean volume decrease rate with SD in each period. The volume of the muscle portion of the pLDMCF decreased at a higher rate than the normal muscle did until the second year postoperatively, and at a rate similar to that of the normal muscle from the third year.

from the vd3 of the muscle portion of the LDMCF, no statistically significant difference was observed between that of the 3 groups. There were also no statistically significant differences between vd4 and vd5 in the 3 groups (Table 3 and Fig. 2).

Altogether, the volume of the muscle portion of the LDMCF decreased by approximately 24% until the second year postoperatively, and from the third year, it shrank with a decrease rate similar to that of the normal muscle. The fat portion of the flap showed no regular volume changes. The volume either increased or decreased, but the range was not wider than that in the other groups. There were no cases of hematoma, seroma, infection, or fat necrosis among the study subjects.

DISCUSSION

After breast reconstruction using the pLDMCF, the volume of the flap changes over time, resulting in a change in the breast shape and a decrease in patient satisfaction. Furthermore, the flap volume occasionally decreases more than expected, distorting the breast shape, and sometimes the flap volume does not decrease as expected, due to which the patient feels like there is a lump in the breast.

Although previous studies have examined the volume change of the myocutaneous flap over time, they analyzed only the volume change of the entire flap without distinguishing the muscle portion and the fat portion.[3–6] In addition, studies have also been conducted to evaluate flap changes after breast reconstruction using the pLDMCF, but they had analyzed only the changes in the size of the muscle portion of the flap without including the fat portion.[7,8] The literature also reports studies analyzing the volume changes by dividing the muscle and fat portions in cases of reconstruction using the myocutaneous free flap after head and neck cancer surgery. For instance, Sakamoto et al used the rectus abdominis myocutaneous free flap, where the muscle volume decreased continually after surgery and decreased by approximately 60% at 1 year, whereas the fat portion decreased until 3 months

Table 3. Comparison of the Volume Decrease Rate of the Muscle and Fat Portion of LDMCF and Contralateral Latissimus Dorsi Muscle (Control) by Time (T), Group (G), and Time* Group (T*G)

	Time, mean (%) ± SD					*P*		
Group	t1	t2	t3	t4	t5	T	G	T*G
Muscle (m)	13.0 3.0.4	11.4 1.0.5	5.7.70.5	2.8.80.5	2.3.30.6	0.000*	0.000*	0.000*
Control (c)	2.0.00.4	2.2.20.5	2.0.00.5	2.2.20.5	2.7.70.6	t1, t2 > t3, t4, t5†	m > c, f†	t1, t2 > t3, t4, t5†
Fat (f)	−0.6.60.4	0.2.20.5	1.0.00.5	0.2.20.5	0.0.00.6			

*Statistically significant, with $P < 0.05$.
†Multiple comparison result by contrast.
t1: period between postoperative 6 month and 1 year; t2: period between postoperative 1 year and 2 year; t3: period between postoperative 2 year and 3 year; t4: period between postoperative 3 year and 4 year; t5: period between postoperative 4 year and 5 year.

and then increased again. At 1 year, it was found to be reduced by approximately 15% compared with that at 1 month after surgery.[9] Yamaguchi et al used the anterolateral free flap and the vastus lateralis muscle free flap, and found that at an average time of 12.1 months, the volume of the muscle flap was 50% of the volume immediately after surgery. It also continued to decrease in volume, and the authors claimed that the primary cause for this was muscle denervation. On the other hand, the fat portion of the anterolateral flap was reported to increase in volume depending on the host condition.[10]

In breast reconstruction, the pLDMCF is elevated with varying muscle and fat ratios depending on the operator and the defect of breast situation. As the volume change patterns of the muscle and fat are different, an objective analysis of each volume change pattern could help the operator to design an appropriate flap.

The volume reduction rates of the muscle portion of the LDMCF in the patients in this study were 26% at 2 years postoperatively, 27% at 3 years, 28% at 4 years, and 29% at 5 years compared with those at 6 months postoperatively. This rate is relatively lower than that reported by other studies.[4–7,9,10] Gido et al evaluated the volume of the latissimus dorsi myocutaneous free flap using CT scans. They performed CT imaging 2 times—the first between 3 weeks and 3 months, and the second at least 1 year after surgery. They found that the mean volume reduction between the 2 CT scans was 34.4%, which is a higher volume reduction rate than that observed in our study. This difference could be due to several reasons: first, the first CT scan was taken earlier than ours; second, the duration between the 2 CT scans varied from 10 to 47 months; third, the muscle of the flap was denervated; and finally, high-dose adjuvant radiotherapy was used for treating the head and neck cancer.[6]

Muscle flaps undergo disuse atrophy as the origin and insertion sites get detached, leading to a decrease in their volume.[11] Moreover, it is known that elimination of neurotrophic stimulation on the muscle or denervation causes muscle atrophy.[11–15] In fact, an earlier experimental study conducted by Yoshitatsu et al[14] had investigated the effect of the neurotrophic stimulation on muscle volume in the muscle flap. In their study with rats, they transected the thoracodorsal nerve and resutured it to the sensory nerve to preserve the sensory nerve in breast reconstruction using the pLDMCF. At that time, the authors argued that it was necessary to preserve the volume of the latissimus dorsi muscle.[14] Similarly, Oswald et al mentioned that nerve innervation was necessary to preserve the muscle volume of the pedicled gracilis flap in comparison with denervated flaps.[15] However, those studies did not perform a quantitative analysis of the muscle volume. In another study, using magnetic resonance imaging (MRI) and histological examination, Kaariainen et al analyzed whether muscle atrophy due to denervation affects volume changes at 1 and 12 months postoperatively. They divided the entire study population into 2 groups, half with denervation and half without. Histological analysis revealed that the atrophy of muscle fibers was significantly higher in the denervation group, but the fatty infiltration among the muscle fibers was also higher. On the other hand, magnetic resonance imaging findings revealed no difference in volume between the 2 groups. Although the authors did not analyze the volume changes after 12 months, their study suggested that not only muscle atrophy but also fatty infiltration should be considered for volume changes of the muscle flap.[7] In our study, the thoracodorsal nerve was preserved in all patients, which suggests that the muscle volume of the pLDMCF is relatively preserved.

Limitations of our study are small sample size, lack of immediate postoperative data, initial flap volume, and body mass index at all CT scans. In an earlier study, Hiraki et al investigated the volumes of the rectus abdominis myocutaneous flap, the pectoralis major myocutaneous flap, and the LDMCF at 1, 6, and 12 months postoperatively. The residual volumes of the flaps were 78.1% at 6 months and 71.4% at 12 months.[5] Similar to this, in the early 6 months after the surgery, the volume of the muscle most likely changes, and if we can add data in the immediate postoperative period, we can supplement this result. Also, if the initial flap volume was measured in the operation room, it would have been a good way to check how similar the volume measured using CT is to the actual flap volume. The volume of fat portion is thought to be related to the patient's nutritional status, and it would be helpful to evaluate the relationship between the changes in body mass index and fat volume.

In general, when a person ages, his/her physical activity decreases, which could at least partially be responsible for the change in muscle distribution with age. Kubo et al measured the volumes of the vastus lateralis, medial gastrocnemius, and triceps brachii muscles of 224 healthy women aged 20–79 years and found that the volume of the vastus lateralis and gastrocnemius muscles decreased with age.[16] Therefore, we compared the volume reduction rate of the latissimus muscle of the healthy side and the muscle portion of the flap. From the third year postoperatively, there was no statistical difference in the rate between the 2 groups, with the average volume reduction rate of the group in the muscle portion of the flap being slightly higher than the rate in the normal muscle group. The disuse atrophy of the detached muscle and that of the normal muscle are likely to be different, which may require further study with a larger sample size.

We divided the muscle and fat portions of the flap and confirmed the volume reduction rate of each portion with time. According to CT images, the primary cause of the volume change over time was the volume reduction of the muscle portion. In this study, the average volumes of the fat portion of the LDMCF were 100.6% ± 1.0% at 1 year postoperatively, 100.3% ± 1.2% at 2 years, 97.9% ± 4.5% at 3 years, 97.2% ± 6.0% at 4 years, and 97.5% ± 5.1% at 5 years, indicating little volume changes in the fat portion. However, the volume of the fat portion of the flap has been debated. Fujioka et al reported that the fat volume of the flap decreased to 84% after 10 months in the group of patients who received only free flap without radiotherapy for head and neck cancer, but the authors did not mention the reason for this decrease.[17] However, Yamaguchi et al reported that in the long-term follow-up, the fat volume of the flap increased at various time points and that the final volume did not change, a result similar to our data.[10]

Therefore, among the myocutaneous flaps, the volume reduction rate of the total flap will vary according to the composition ratio of muscle and fat. Amir et al tailored the flap 10% larger than the resected mass, taking into account the muscle and fat atrophy or necrosis that occurred during transverse rectus abdominis myocutaneous (TRAM) flap reconstruction.[3] However, in TRAM flaps, muscles are only a fraction of the total flap, which is primarily the pedicle; hence, the reconstructed breast is largely made up of fat tissue. Therefore, this study also had a limit to be applied to the LDMCF. According to CT findings, the volume of the muscle portion changed to 76.0% ± 7.6% at 2 years compared with that at 6 months postoperatively, but the fat portion showed a volume change of 100.3% ± 1.2%. This also related to the change in the shape of the breast. The volume of the underarm and lateral breast area where the flap pedicle traveled was reduced more than that in other areas. On the other hand, the region filled with the fat portion of the flap was remained relatively unchanged. Therefore, it is possible to increase the patient's satisfaction by minimizing the volume change of the flap by maximizing the relatively stable fat portion rather than the muscle portion. If the defect is small and there is adequate subcutaneous tissue on the back, thoracodorsal artery perforater flap may be a better option in terms of long-term results.

The patients in our study received postoperative radiotherapy with 1 exception. The myocutaneous flap primarily consists of the skin, fat, and muscle. Jurdana claimed that therapeutic doses of radiation induce muscle atrophy in children. In case of a developing skeletal muscle, therapeutic dose radiation can induce apoptotic cell death and muscle necrosis by causing damage to capillaries and connective tissue. Muscle atrophy, resulting in myofiber degeneration and reduction of satellite cell population, was also observed. However, the adult skeletal muscle is considered to be resistant to ionizing radiation unless higher doses of radiation are applied, and instead of atrophy, it could undergo irreversible fibrosis.[18]

Fat is also known to cause cell changes after irradiation. For instance, Poglio et al reported that irradiation damaged the subcutaneous adipose tissue by altering both mature adipocytes and stromal vascular fraction cell functions in rats. These acute effects may further modify the reconstructive capacity of the adipose tissue, which therefore renders its use questionable in autologous fat transfer before radiotherapy.[19] This concept has been primarily investigated in head and neck cancer with a large irradiation dose of approximately 70 Gy.[4–6,9,10] Sakamoto et al reported that after a 12-month follow-up after RAM flap reconstruction, the group treated with radiation showed significantly reduced volume in both muscle and fat layers compared with that in the group that was not treated with radiation.[9] On the other hand, Bittermann et al reported that the average volume reduction rate was higher in the adjuvant radiotherapy group (39% versus 31%) but without statistical significance, indicating that objective studies on the effect of radiation on flap volume were inconsistent.[6]

In the area of breast cancer, studies have investigated the effect of postmastectomy radiation therapy (PMRT) on flap volume. Some authors have claimed that PMRT affects flap volume,[1,20–22] whereas others claim the opposite.[23–33] Myung et al investigated the effect of radiotherapy on flap volume by comparing the flap volume with and without radiation therapy after breast reconstruction using free TRAM flap. They observed that in the radiotherapy group, the flap volume decreased by 12.3% at 1218 months postoperatively, which was significantly different from the flap volume recorded immediately after radiotherapy. On the other hand, in the nonradiotherapy group, the flap volume decreased by 2.6% on average, and there was no significant difference between the flap volumes at 3—6 months postoperatively. However, the authors reported that fat necrosis and postoperative infection were higher in the radiation group than in the nonradiation group. They did not report on the relationship between these complications and flap volume differences, and it remains unknown whether radiation affects flap volume without such complications.[1] In fact, Halyard et al reviewed data from patients who received radiation after TRAM flap reconstruction and found that there were 8 fat necrosis cases of the total 15 cases, 6 of which occurred before radiation.[31] It is necessary to confirm the relationship between PMRT and fat necrosis and the volume change of the fat tissue in the flap without fat necrosis. On the other hand, Chatterjee et al measured volume using a mammometer 1 year after deep inferior epigastric artery perforator (DIEP) flap. They found no significant difference in volume change over the 1 year between the radiation—treated group and the untreated group.[23] There was a disagreement with the claim whether PMRT affects flap volume or does not. This difference between these findings is believed to be due to the relatively low radiation dose of 50 Gy in breast cancer, which is less likely to cause late complications leading to flap volume change. Therefore, further research is needed on this aspect. In the present study, there were no data on flap volume before radiation treatment, and only 1 patient was not treated with radiation. If flap volume data before radiation treatment and data for patients not receiving radiation treatment were added, the results could be statistically verified.

SUMMARY

The primary cause of volume changes over time in the pLDMCF is atrophy of the muscle portion. When the flap is used for breast reconstruction, it is possible to increase patient satisfaction by minimizing the volume change of the flap by maximizing the relatively stable fat portion rather than the muscle portion.

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