



Surgical Intervention for Refractory Donor-Site Seroma After Immediate Breast Reconstruction with Latissimus Dorsi Flap

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Abstract Donor-site seroma persisting for > 3 weeks is the most common complication of latissimus dorsi (LD) flaps for breast reconstruction after mastectomy. Conservative treatment is insufficient for refractory seroma resolution. We report the results of surgical intervention for refractory donor-site seroma. Between January 2012 and April 2018, 319 patients undergoing breast reconstruction using an LD flap at our hospital were treated with conservative therapy if seroma was found. Refractory seroma of > 3 months' duration was observed in five patients (1.6%). Before surgery, the precise location and extent of the capsule were determined using chest computed tomography, and surgical intervention was planned. An en bloc capsulectomy was performed after confirming the internal capsule. Simultaneously, a quilting suture, bolster suture, and fibrin sealant were applied to prevent recurrence. The mean age of the patients with refractory seroma was 45.4 (\pm 7.3) years, and their mean body mass index was 31.0 (\pm 6.2) kg/m². All patients underwent breast reconstruction with an extended LD flap or extended LD flap with a silicone implant after total mastectomy. During the follow-up period of \geq 10.4 months, a mean of 34.4 (\pm 10.4) needle aspiration procedures were performed, and a mean of 12.8 (\pm 2.2) cc of seroma fluid was removed each time. Intraoperatively, the formation of a

capsule with a well-defined border was confirmed; all patients showed complete resolution of donor-site seroma within 4 weeks after surgical intervention. Refractory donor-site seroma occurrence was rare in the cases assessed. Surgical intervention was successful in cases of refractory donor-site seroma unsuccessfully treated with conservative therapy and is thus one of the most effective methods for complete resolution of refractory seroma.

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Keywords Refractory donor-site seroma · Breast reconstruction · Latissimus dorsi flap

Introduction

The latest trend in breast cancer treatment is to consider treatments with proven oncological safety that also ensure good aesthetic outcomes from immediate breast reconstruction. Among such methods, autologous breast reconstruction with the latissimus dorsi (LD) flap is the predominantly used method [1]. This approach has become one of the most highly touted autologous breast reconstruction methods; it is highly effective, offers good aesthetic outcomes and high patient satisfaction, and causes minimal morbidity [2, 3]. Radiation therapy following breast reconstruction with the LD flap has shown no specific complications, although there is a new paradigm of operations that combine the LD flap and implant, which has been reported to be very useful [4]. However, seroma has been reported as the most common complication at the

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LD flap donor-site, with one study reporting an incidence rate of up to 96% [5]. In most cases, complications involving seroma can be managed by conservative treatment, but once such complications occur, they can lead to secondary problems such as wound dehiscence, infection, and/or inflammation. Consequently, the level of discomfort and anxiety experienced by the patient increases, which eventually causes patient satisfaction to decrease. Various methods for reducing such complications, including the use of fibrin sealant after applying compressive dressing, infiltration of steroids or sclerosing agents (bleomycin, OK-432), and reduction of the use of electrocautery, which can increase the likelihood of seroma formation, are being studied [5–12].

In some recurrent cases, seroma may reappear during tumor treatment (chemotherapy and radiotherapy) after initial resolution, while in other recurrent cases, it may appear as unresolved seroma persisting for more than 6 months despite conservative treatment. Although there are methods that can be used to reduce complications, such as conservative treatment or intraoperative methods (including the use of fibrin glue and progressive tension closure), there is no established protocol for properly treating refractory LD donor-site seroma. Accordingly, this retrospective study aimed to assess the use of surgical intervention to successfully treat refractory LD donor-site seroma persisting for more than 6 months in patients who underwent breast reconstruction with the LD flap.

Patients and Methods

Among 319 patients who underwent breast reconstruction with the LD flap by a single surgeon at our hospital between January 2012 and April 2018, five patients with unresolved refractory LD donor-site seroma persisting for more than 6 months, despite conservative management, were selected for the study. We conducted a retrospective analysis.

We investigated age, body mass index (BMI), pathologic diagnosis, operation method, mastectomy weight, preoperative breast volume, adjuvant therapy, number of aspirations, refractory seroma duration, underlying disease, axillary lymph node dissection, and LD flap size. We also investigated the number and amount of seroma formation by post-discharge outpatient examinations during the follow-up period.

All LD flaps were designed by a single surgeon according to the mastectomy weight and volume. To minimize intraoperative injury to the lymphatics and vessels, a bipolar device, instead of electrocautery, was used for dissection and sealing. After transferring the LD flap to the mastectomy site, saline irrigation (500 cc), bleeding

control, lymphatics sealing using the LigaSure Small Jaw (Covidien, Boulder, CO) sealing device, and a fibrin patch were performed on the donor-site. In total, 4 ml of fibrin glue (spray type) was evenly sprayed on the site, and 800 cc of negative drain (Barovac, Sewoon Medical, Seoul, South Korea) was applied on the donor-site in two lines, directed toward the inferior-most and axillary parts. Quilting suture, which may affect the healing process due to inadequate traction, was performed not too forcefully.

The average length of hospital stay was approximately 2 weeks. During the hospital stay, if the amount of drainage from the donor-site exceeded 50 ml on postoperative day 10, the site was irrigated with a two-vial infiltration with steroid (triamcinolone 50 mg/5 ml) and, to ensure that the infiltration was applied evenly, the negative drain was clamped for 20 min and compressive dressing was applied. If the amount of drainage checked on 2 consecutive days was below 30 ml, irrigation was complete and the patient was discharged.

Patients' progress was monitored through outpatient follow-up within 1 week from discharge. If seroma had occurred, percutaneous aspiration was performed on the site of seroma formation using a scalp vein set with a 24-G needle, and an elastic bandage was applied for compression. In cases with seroma formation, progress was monitored every 3–4 days by outpatient follow-up, and aspiration was performed, and intralesional steroid infiltration (triamcinolone, 5 mg/5 cc) mixed with 5 cc of normal saline was applied 2–3 times every 2–3 weeks. In cases with recurrence despite 2–3 rounds of lesional steroid infiltration and needle aspiration, Abnoba-viscum (1 mg/cc) mixed with 5 cc of normal saline was applied 2–3 times every 2–3 weeks. For refractory seroma that persisted for more than 6 months despite such treatment, surgical intervention was planned (Fig. 1).

Preoperative chest computed tomography (CT) was used to check for the range and location of the capsule that had formed, its relation to surrounding tissues, and abnormalities, such as fistulae (Fig. 2). Surgery was performed under general anesthesia, in which the capsule was identified by dissection with an approach using the previous LD flap surgical scar. Subsequently, the capsule surrounded by fibrous tissue was removed by complete en bloc resection. After inserting 400 cc of negative drainage (Barovac, Sewoon Medical, Seoul, South Korea) via two lines into the inferior part of the capsule with the refractory seroma in the center, 2 ml of fibrin sealant (spray type) was sprayed evenly and 2–0 Vicryl (Ethicon, Inc., Somerville, NJ) was used to perform quilting sutures (3–4 cm apart starting from the inside), while making sure adequate traction was achieved. If the seroma capsule size was $\geq 10 \times 10$ cm, 2–0 nylon was used to perform bolster sutures (3–4 cm apart) that pierce the skin to minimize the formation of

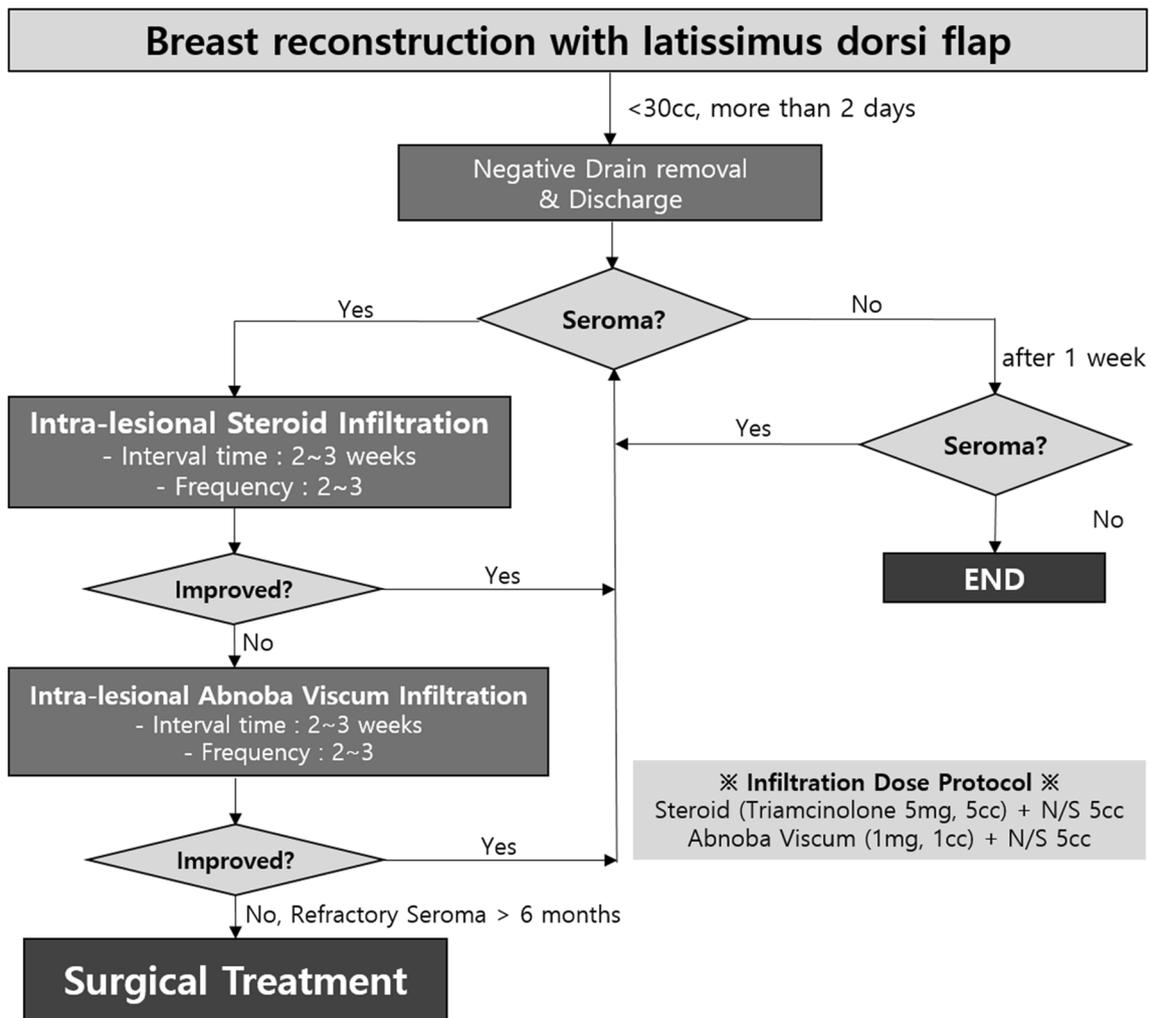


Fig. 1 KNUH treatment protocol: refractory donor-site seroma after breast reconstruction with latissimus dorsi flap

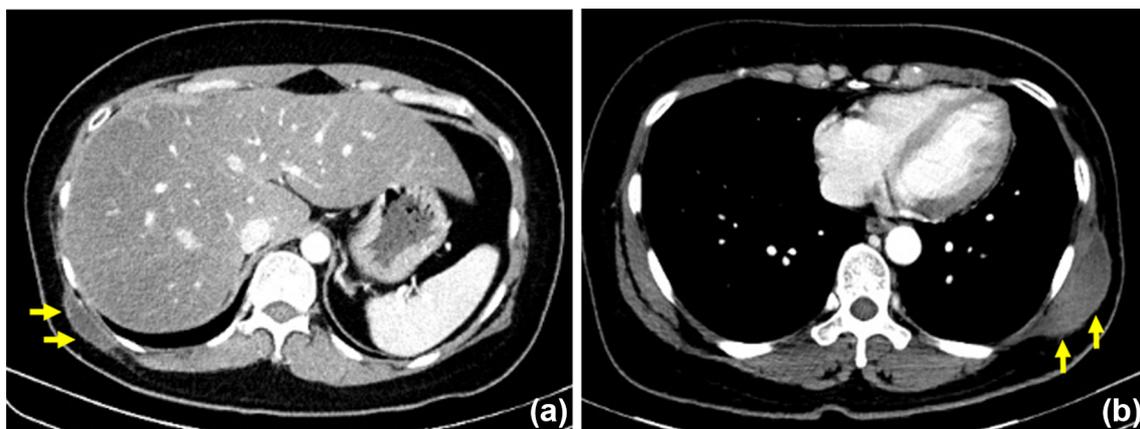


Fig. 2 Chest computed tomography. **a** Capsulated seroma formation on the upper part of the incision site in the right LD flap donor-site in a case involving right breast cancer (yellow arrows). **b** Capsulated

seroma formation on the lower part of the incision site in the left LD flap donor-site in a case involving left breast cancer (yellow arrows). LD, latissimus dorsi

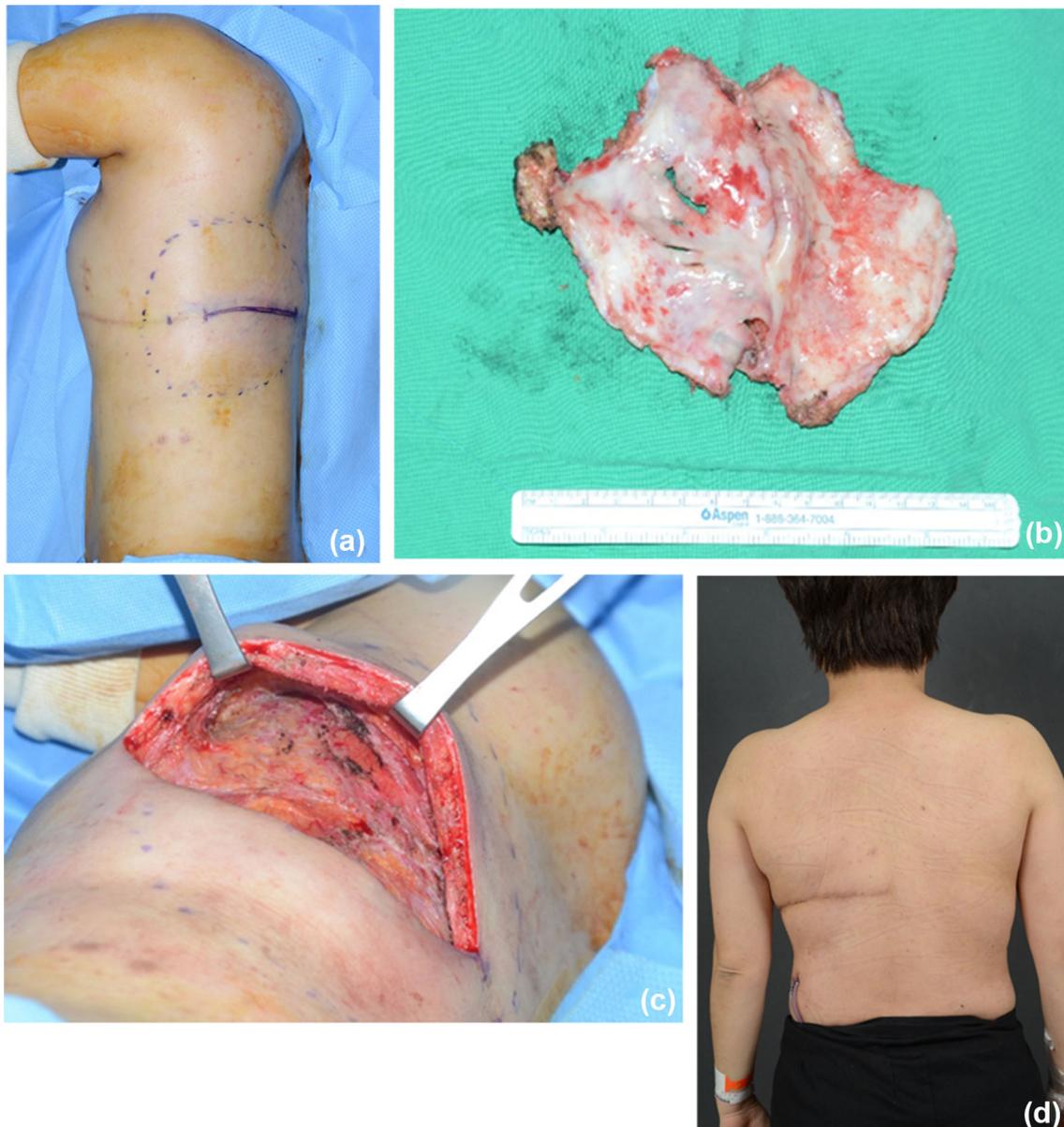


Fig. 3 Patient photographs. **a** Preoperative finding. A bulge in the back area is seen. **b, c** Intraoperative finding. En bloc capsulectomy was performed. **d** Postoperative findings confirm complete resolution

dead space, so that the likelihood of recurrence due to shearing force generated by arm motion could be minimized. The incision site was closed, layer by layer, using 2–0 and 4–0 Vicryl and 5–0 Ethilon sutures (Ethicon, Inc., Somerville, NJ, USA) (Fig. 3). After confirming that there were no limitations in arm movement due to quilting and bolster sutures, the negative drain lines were checked to make sure that they were not sutured and the surgery was completed. The patient was discharged if the amount of drainage checked on 2 consecutive days was below 30 ml. Outpatient follow-ups were conducted in accordance with this protocol for seroma, and the number of postoperative

outpatient follow-ups and recurrence of seroma were checked and analyzed.

For pathologic evaluation of the capsule excised during the surgery, hematoxylin and eosin, trichrome, and Sirius Red staining were performed.

We used SPSS 22.0 (IBM Corp., Armonk, NY, USA) for statistical analysis, and correlations between parameters were analyzed using logistic regression tests. First, we analyzed the patient's age, BMI, final diagnosis (ductal carcinoma in situ, invasive ductal carcinoma, or invasive lobular carcinoma), type of mastectomy method used by the breast surgeon (partial or total mastectomy), adjuvant therapy (chemotherapy and/or radiotherapy), axillary

lymph node dissection (ALND), number of aspirations, refractory seroma duration, surgical intervention method (capsulectomy, quilting suture, or bolster suture), and LD flap design size (4×17 , 5×15 , or 6×18 cm). *P* values less than 0.05 were considered significant.

Results

In the five patients with refractory seroma persisting for more than 6 months who underwent surgical intervention in accordance with the Kyungpook National University Hospital (KNUH) refractory seroma treatment protocol, the mean age was 45.4 (± 7.3) years; mean BMI was 31.0 (± 6.2) kg/m²; mean number of percutaneous aspirations was 36.6 (± 2.4) times; mean duration of persistent refractory seroma prior to surgery was 10.4 (± 4.7) months; mean mastectomy weight was 437.6 (± 17.2) g; and mean preoperative breast volume was 398 (± 26.9) cc. All patients underwent reconstruction with the LD flap after mastectomy, while a permanent implant was inserted together with the LD flap to match the breast volume in two patients (Table 1). Among the five patients, mild seroma was observed in only two patients, but complete resolution was achieved by conservative treatment using percutaneous aspiration and compressive therapy.

The statistically significant correlations were observed between BMI and refractory seroma duration; number of aspirations and reconstruction type; surgical intervention method and mastectomy type; and LD flap size and excised mass weight (*p* value 0.009, 0.043, 0.001, and 0.05, respectively). There were no significant differences found with respect to axillary lymph node dissection (Table 2).

In the histological evaluation of such capsules, vessels were observed in-between thick fibrotic tissues, but no inflammation was found. It was confirmed that such thick capsular tissue caused the patient to show firmness and

acted as a factor that impaired adhesion in the wound healing process (Fig. 4).

Discussion

Breast reconstruction is increasingly considered to be an essential part of breast cancer treatment, as it plays an important role in improving the quality of life of these patients. In breast reconstruction, the LD flap is very useful and has reliable vascularity, and breast reconstruction using the LD flap has become more popular since it is relatively simpler compared to other surgical methods [13–17].

However, donor-site seroma that may occur after reconstruction with the LD flap can cause discomfort in both the patient and surgeon and lead to secondary complications, such as infection, inflammation, and wound dehiscence. Refractory seroma that persist for a long time can affect oncological treatment, such as radiotherapy and chemotherapy. Various studies are being conducted to minimize the occurrence of such problems. Among surgical interventions, fibrin glue applied directly to the donor-site is being developed as spray and patch types containing various hemostatic agents and other components that help wound healing. Moreover, based on the view that the risk for seroma increases in surgery using monopolar electrocautery (a surgical tool) due to injury to lymphatics and vessels caused by dispersion heat to the nearby area, various methods based on the development of sealing devices are being attempted. Other methods include suture techniques using the progressive tension closure method and the conventional technique using delicate, adequate quilting sutures, which may also be combined with postoperative compressive therapy.

For recurrences after removing the main drain, a minimal suction method using a needle is performed to minimize the formation of dead space, prevent capsule

Table 1 Patients' characteristics of refractory donor-site seromas after breast reconstruction with the latissimus dorsi flap

No	Age	BMI	Dx	Mastectomy types	Reconstruction types	Mass weight (g)	Preoperative breast volume	Adjuvant therapy	ALND	Aspiration (times)	Duration (months)	Flap size
1	55	38.95	ILC	SSM	LD implant	402	340	CTx	x	44	14	6 × 18
2	36	26.19	IDC	SSM	LD implant	593	450	RTx + CTx	o	45	7	6 × 18
3	46	30.12	IDC	SSM	LD	400	380	RTx + CTx	x	20	7	5 × 15
4	41	35.50	IDC	SSM	LD	678	580	CTx	o	32	12	6 × 18
5	49	24.15	IDC	PM	LD	115	240	RTx + CTx	o	31	6	4 × 17

BMI body mass index, *Dx* diagnosis, *ILC* invasive lobular carcinoma, *DCIS* ductal carcinoma in situ, *IDC* intraductal carcinoma, *SSM* skin sparing mastectomy, *PM* partial mastectomy, *LD* latissimus dorsi flap, *LD implant* latissimus dorsi flap with silicone implant, *CTx* chemotherapy, *RTx* radiotherapy, *ALND* axillary lymph node dissection

Table 2 Statistical analysis of refractory seroma evaluation using multiple regression analysis

	Age	BMI	Dx	Mastectomy types	Reconstruction types	Mass weight	Preoperative breast volume
Adjuvant therapy	0.593	0.028*	0.272	0.495	0.789	0.469	0.452
ALND	0.247	0.367	0.272	0.495	0.789	0.805	0.657
Aspiration	0.925	0.752	0.371	0.768	0.043*	0.669	0.914
Refractory seroma duration	0.505	0.009*	0.142	0.389	0.584	0.491	0.545
Surgical intervention	0.654	0.270	0.685	0.001**	0.495	0.082	0.192
Flap size	0.626	0.231	0.534	0.052	0.272	0.050*	0.157

BMI body mass index, Dx diagnosis, ALND axillary lymph node dissection

* $p < 0.05$, ** $p < 0.01$

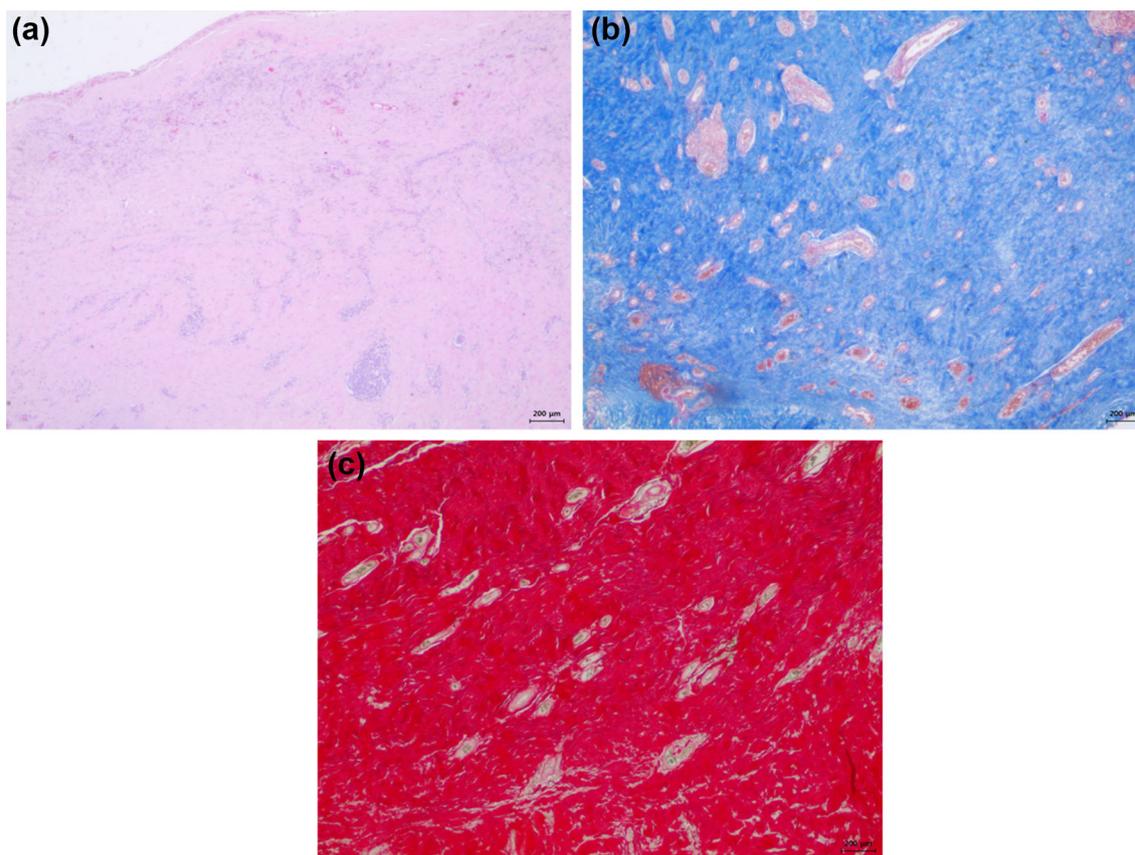


Fig. 4 Histological findings. **a** Fibrotic capsule and vasculogenesis were observed (hematoxylin and eosin stain, 40× magnification). **b** Collagen fiber of the capsule appeared as blue color (trichrome

stain, 100× magnification). **c** Fibrotic capsule appeared as red color, while the parts appearing in yellow represent vessels (Sirius-red stain, 100× magnification)

formation, and help wound healing to allow adhesion to prevent seroma formation [17]. While various studies are being conducted on resolving the complication of seroma formation, analyses to identify risk factors that increase the likelihood of seroma formation are also being conducted. According to Jeon et al., obese patients with a high BMI showed a high incidence of seroma, with higher incidence being associated with bigger flap size [18]. According to

Gruber et al., their statistical approach showed that perioperative selective serotonin reuptake inhibitors and calcium balance also influenced the incidence of seroma formation [19].

In the statistical analysis, refractory seroma duration showed a statistically significant correlation with BMI. The present study also confirmed that BMI, which was reported to be a risk factor in other studies, can affect the incidence

of seroma. ALND, which has been highlighted as another risk factor for seroma formation, did not show significant correlations [18, 19]. However, the patient group that underwent reconstruction using the LD flap plus silicone implant due to their large breast volume showed a statistically significantly higher number of aspirations than the group who underwent reconstruction using only the LD flap. With respect to surgical intervention, a wider capsule formation area ($\geq 10 \times 10$ cm) was correlated with an increased number of quilting and bolster sutures after en bloc capsulectomy; thus, the patient group that underwent total mastectomy showed significant correlation. Moreover, LD flap size showed significant correlation with respect to excised mass weight. Overall, this can be analyzed as higher mastectomy weight requiring larger flap design, and thus, the site of reconstruction could be confirmed statistically (Table 2).

Capsule formation due to long-term seroma formation could be identified by physical examination, and high-density capsules were also clearly visible on perioperative CT imaging (Fig. 2). Based on histologic findings, it is believed that it would be difficult to resolve refractory seroma that persists for a long time by conservative management (Fig. 4).

The protocol used in the present study has the advantage of easily allowing postoperative conservative management through our outpatient clinic, but it also has the disadvantage of not being able to fundamentally resolve the occurrence of seroma. We are continuing an investigation into cause analysis and hope to be able to provide positive results in the future.

Accordingly, we report that if delicate en bloc capsulectomy is used as a surgical intervention for refractory donor-site seroma persisting for more than 6 months after immediate breast reconstruction with the LD flap and care is provided by adequate quilting sutures together with bolster sutures proportional to the area of onset, then such a method can serve as a protocol for overcoming seroma complications for both the patient and surgeon.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest to disclose.

Human and Animal Rights This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent is not required for this type of study.

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