



Bilateral breast reconstruction and pectus excavatum correction: a case and review of the literature

Toshihiko Satake¹  · Mayu Muto¹ · Seiko Kou² · Jun Sugawara³ · Kazutaka Narui⁴ · Shinji Kobayashi⁵ · Takashi Ishikawa⁶ · Jiro Maegawa⁷

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Abstract

Pectus excavatum is a chest wall malformation characterized by anterior chest wall depression. It is often associated with hypoplastic breasts, sternal rotation, and consequent breast asymmetry. We present here the case of a 52-year-old female with pectus excavatum, a bilateral nipple-sparing mastectomy for breast cancer, and immediate autologous breast reconstruction using bilateral deep inferior epigastric perforator flaps. To correct reconstructed breast deformities and pectus excavatum depression and to enhance breast volume to treat hypoplastic breasts, three sessions of Brava-assisted fat grafting were performed. These postoperative courses were uneventful and without any complications. The patient was satisfied with the final esthetic results. There are only two case reports to perform bilateral breast reconstruction and surgical correction of pectus excavatum, which were used with both pedicle musculocutaneous flap and breast implant, with or without a sternal implant. In this study, we discuss indications and surgical options for bilateral breast reconstruction, pectus excavatum, and breast augmentation. Level of Evidence: Level V, therapeutic study.

Keywords Pectus excavatum · Breast cancer · Breast reconstruction · Deep inferior epigastric artery perforator flap · Breast augmentation · Fat grafting

Introduction

Pectus excavatum is the most common chest wall malformation. Its characteristic anterior chest wall depression is often accompanied with hypoplastic breasts, sternal rotation, and breast asymmetry in female patients [1]. To date, various operative techniques have been described to treat chest wall deformities using skeletal elevation with the Ravitch [2] or Nuss [3] procedures, or to correct asymmetric hypoplastic breasts

with procedures such as breast implant [4, 5], local flap [6], pedicle flap [7], free flap [8, 9], and fat grafting [1, 10]. However, the skeletal elevation is invasive and cannot be easily indicated for aged female patients with no cardiopulmonary dysfunction. Since the surgical indications for this type of patients are mainly for esthetical and psychological improvement, soft tissue correction using breast implant [4, 5], autologous tissues such as local flap [6], pedicle flap [7], free flap [8, 9], fat grafting [1, 10], or free flap with implant [11] is less

✉ Toshihiko Satake
toshi@yokohama-cu.ac.jp

¹ Department of Plastic and Reconstructive Surgery, Yokohama City University Medical Center, 4-57 Urafune-cho, Minami-ku, Yokohama, Kanagawa 232-0024, Japan

² Department of Plastic and Aesthetic Surgery, KO Clinic for Antiaging, 4-54 Onoe-cho, Naka-ku, Yokohama, Kanagawa 231-0015, Japan

³ Department of Plastic Surgery, Cosmetic Surgery and Skin Beauty Dermatology, JUN CLINIC, 1402 Kita Ishido-cho, Nagano, Nagano 380-0826, Japan

⁴ Department of Breast and Thyroid Surgery, Yokohama City University Medical Center, 4-57 Urafune-cho, Minami-ku, Yokohama, Kanagawa 232-0024, Japan

⁵ Department of Plastic and Reconstructive Surgery, Kanagawa Children's Medical Center, 2-138-4 Mutsukawa, Minami-ku, Yokohama, Kanagawa 232-8555, Japan

⁶ Department of Breast Surgery, Tokyo Medical University Hospital, 6-7-1 Nishishinjuku, Shinjyuku-ku, Tokyo 160-0023, Japan

⁷ Department of Plastic and Reconstructive Surgery, Yokohama City University Hospital, 3-9 Fukuura, Kanazawa-ku, Yokohama, Kanagawa 236-0004, Japan

invasive and preferred. This manuscript describes our experience with an elderly female pectus excavatum patient who has undergone bilateral breast cancer surgeries and immediate breast reconstruction using bilateral deep inferior epigastric perforator (DIEP) flaps. Not only the breast cancer sequelae but also the chest wall deformity and hypoplastic breasts were esthetically improved by three sessions of fat grafting.

Case report

A 52-year-old female patient was referred to us for immediate breast reconstruction following bilateral nipple-sparing mastectomy (NSM) under diagnosis of bilateral invasive ductal carcinoma in both breasts by the Department of Breast Surgery at our hospital. The patient height was 157-cm tall and weighed 49 kg. Her anterior chest wall was posteriorly depressed, and both breasts were hypoplastic and asymmetric because of pectus excavatum, for which she had never undergone any surgical intervention (Fig. 1a–c). Together with the bilateral breast reconstruction, the patient requested a slight breast enlargement and treatment of the chest wall deformity. A bilateral DIEP flap procedure was planned for these corrections.

Patient's cardiopulmonary function, degree of pectus excavatum, soft tissue thickness, and abdominal perforators were preoperatively assessed by X-rays, chest and abdominal three-dimensional enhanced computed tomography (CT), spirometry, and echocardiography. No cardiopulmonary impairment was detected. Chest CT images showed hypoplastic and asymmetric breasts, a sternum depressed to the right side. The pectus excavatum chest wall deformity was a type 2A1, according to Park's morphologic classification (Fig. 2a) [12], where the center of the sternum was in the midline but the maximal depression was in the right costal cartilage and deep focal asymmetric depression. The Haller index was 4.59, and the asymmetry index was 1.23 [13]. The bilateral deep inferior epigastric vessels and the preserved right lateral perforators were identified in abdominal CT images.

Tissue expander breast implant reconstruction appeared difficult, because the breast skin was tight and the pectoralis major muscle was very thin and adherent to the thoracic cage. We suspected that both reconstructed breasts will internally rotate without a pectus excavatum correction. Simultaneous invasive skeletal elevation for pectus excavatum with the Ravitch [2] or Nuss [3] procedures was not indicated for this elderly patient. The patient agreed for an immediate lower abdominal free flap breast reconstruction. However, there was a long pararectal incision scar on her right lower abdomen due to laparotomy under diagnosis of pan-peritonitis from perforated appendicitis.

After bilateral NSM and sentinel lymph node biopsies by lateral vertical incision approach, DIEP flaps were harvested. An incision was made on the right pararectal incision scar,

which formed a border between the left and right DIEP flaps; each flap was elevated. After the skin paddles were denuded, pedicles of the left and right DIEP flaps were anastomosed end-to-end to the right thoracodorsal and left lateral thoracic vessels, respectively. To camouflage the chest wall deformity, the larger left DIEP flap was oriented from the mid-sternum to the right mastectomy defect parallel to the donor site to fill the concave deformity with zone III and the extended upper adiposal lobe (Fig. 3a, b). The smaller right DIEP flap was sutured at the lower edge to form a cone-shape and was mounted onto the left pectoralis major muscle to partially overlap with the medial portion of the left DIEP flap. All donor and recipient wounds were sutured with closed suction drains. A total of 152 g and 139 g of tissue was removed from the left and right breast, respectively. The weight of the final DIEP flap inset was 242 g for the left and 320 g for the right breast. Postoperative course was uneventful and without any complications; although the right infraclavicular hollow remained, the volume of the lower pole breast was insufficient, and the nipple-areola remained to be vertically asymmetrical (Figs. 1d–f and 2b).

Three sessions of complementary fat grafting were performed, each at an interval of over 12 months to improve the reconstructed breast contours and bulk, as well as the chest wall deformity (Fig. 1d–l). To increase microcirculation and graft capacity, the patient was instructed to wear the Brava external tissue expander (Brava LLC, Miami, FL, USA) for at least 8 h/day for 4 weeks before and after each fat grafting session. Steroid cream (betamethasone valerate, 0.12%) was applied for a short period to prevent skin troubles such as blister, erosion, and pigmentation. Fat grafting sessions were performed under general anesthesia. Fat was harvested using the tumescent technique with a 3-mm cannula and a 60-ml syringe. The lipoaspirate was manually centrifuged at 41–71 g for 4 min and then injected through small incisions made with an 18-gauge needle using a 1.6-mm blunt cannula and a 5-ml syringe. The fat was injected from beneath the pectoralis major muscle into the breast subcutaneous plane to correct both the congenital and acquired deformities. A total of 368 ml of fat was transferred from the anterior thigh in the first procedure, 372 ml from the posterior thigh in the second procedure, and 232 ml from the buttock in the third procedure. In the first procedure, superficial dermis of the buried DIEP flap blocked the penetration of the blunt cannula and the expansion of the breast integument. The right infraclavicular hollow, tight skin at the right lower pole of the breast, and the subcutaneous adhesions at the left axillary tail of the breast were thus difficult to correct. An 18-gauge needle was used to make multiple skin perforations and aponeurotomies to release the tight skin and subcutaneous fibrous strings, which allowed to increase the volume of grafted fat.

There was no induration nor lump in either of the reconstructed breasts and chest. Use of the Brava was consistently

Fig. 1 Serial photographs taken before and after surgery. This 52-year-old female with bilateral breast cancer had pectus excavatum without any previous surgical intervention. **a–c** Before surgery. **d–f** One year after immediate breast reconstruction using bilateral DIEP flaps. **g–i** One year after the first fat grafting. **j–l** One year after the third fat grafting

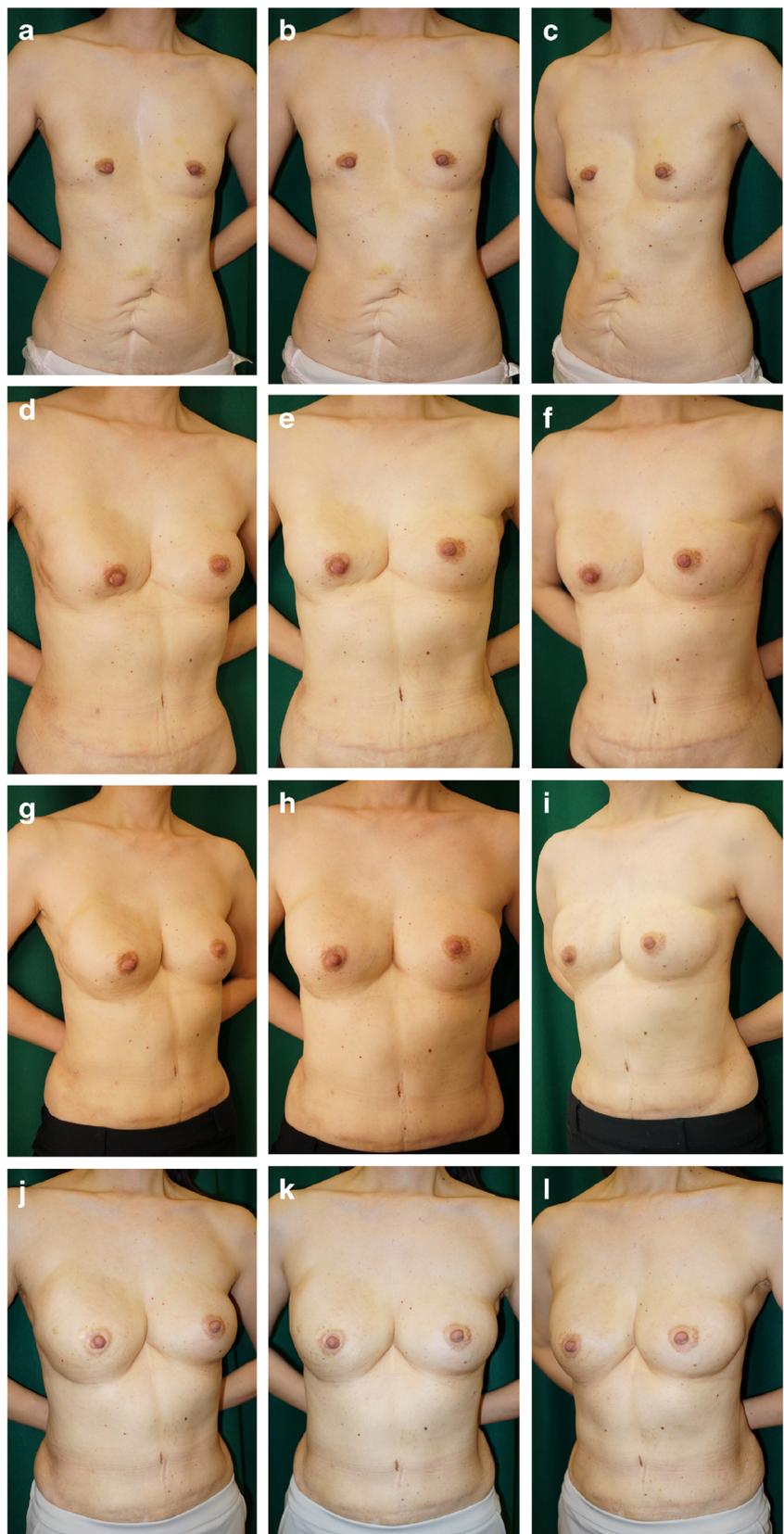
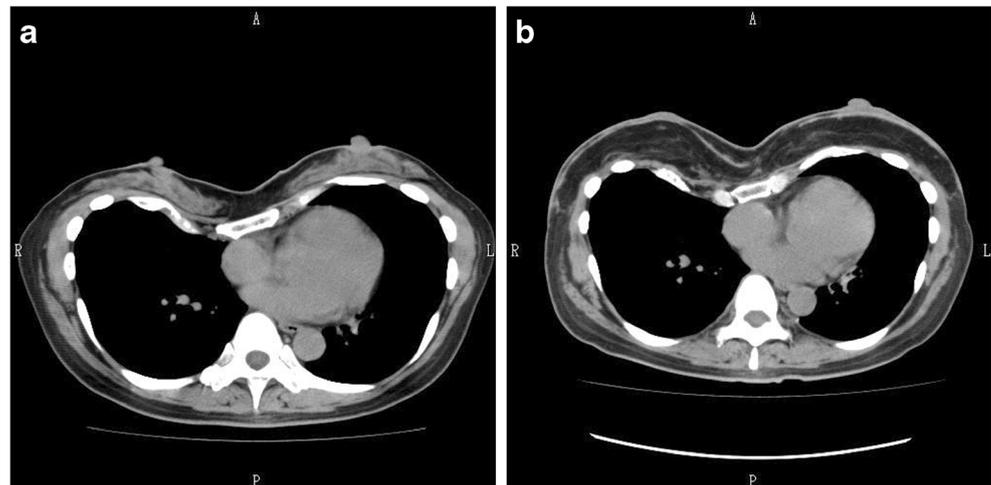


Fig. 2 **a** Preoperative plain computed tomography image showing Park's 2A1 pectus excavatum chest wall deformity, Haller index of 4.59, and asymmetry index of 1.23. **b** Postoperative CT image showing the replacement of both breasts with DIEP flaps and asymmetric nipple-areola positioning



accompanied by contact dermatitis and postpigmentation. Mammograms at 2 years after the final session were normal, but echography and magnetic resonance imaging revealed small oil cysts (Fig. 4). The patient was satisfied with the final results as well as the esthetic improvement following the repair of bilateral breast cancer sequelae and pectus excavatum.

Discussion

Most women with asymmetric pectus excavatum have hypoplastic and asymmetric breasts with no significant difference in breast volume [14]. Indications for correction are primarily esthetical and psychological [8]. Procedures described for esthetic correction of pectus excavatum with breast asymmetry include skeletal correction using the Ravitch [2] or Nuss [3] procedures, soft tissue augmentation using implants [4, 5], local flap or pedicle flap [6, 7], free flap [8, 9], fat grafting [1, 10], free flap with implant [11], and skeletal correction with breast implant augmentation [15–18].

Skeletal correction is an invasive procedure that requires fracturing or remodeling of the chest wall [1, 2], and is generally reserved for young patients and severe cases. Subpectoral breast implantation [4, 5] is less invasive, but

includes risks of seroma, capsular contracture, malposition, or internal rotation [18]. Simultaneous or secondary subglandular [15, 18] or subpectoral [16, 17] implantation with skeletal correction has achieved good esthetic results. In mildly symptomatic cases, autologous procedures alone [6–9], or combined with implants [11], are also effective, mainly for esthetic and psychological improvements.

Fat grafting is an ideal complement to primary procedure for breast reconstruction in plastic surgery. Its advantages include the use of autologous tissue, being less invasive than other techniques, producing minimal scarring, being repeatable and reproducible, and being low in cost [19, 20]. Fat grafting has been used in the surgical correction of congenital chest wall deformities, including pectus excavatum [1, 10], Poland syndrome [21–23], and tuberous or breast hypoplasia [19, 24]. A study including 19 pectus excavatum patients reported an average of 1.63 fat grafting sessions and a total transferred fat volume of 375 ml, and stable results were achieved without complications and with high patient satisfaction [1].

There are only two previous case reports of surgical correction of pectus excavatum in patients with delayed bilateral breast reconstructions, both of which used musculocutaneous flap procedures with implants (Table 1) [25, 26]. The first case

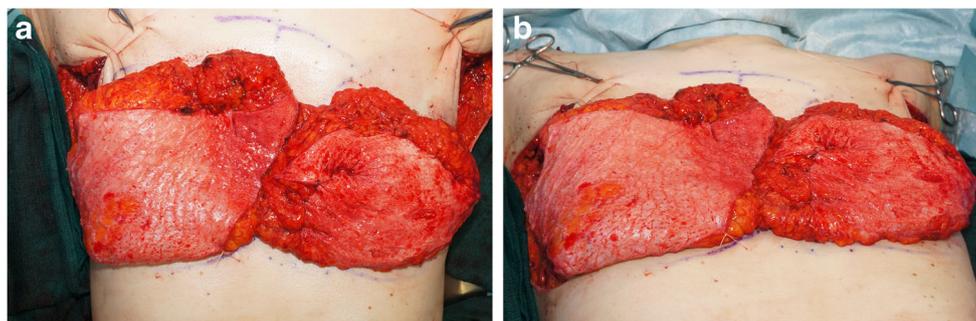


Fig. 3 The larger left DIEP flap was positioned from the mid-sternum to the right mastectomy defect to fill the concave deformity with zone III and an extended upper adiposal lobe. The smaller right DIEP flap was

sutured at lower edges to form a cone-shape. It was then mounted onto the left pectoralis major muscle, which partially overlapped the medial portion of the left DIEP flap. **a** Frontal view. **b** Basal view

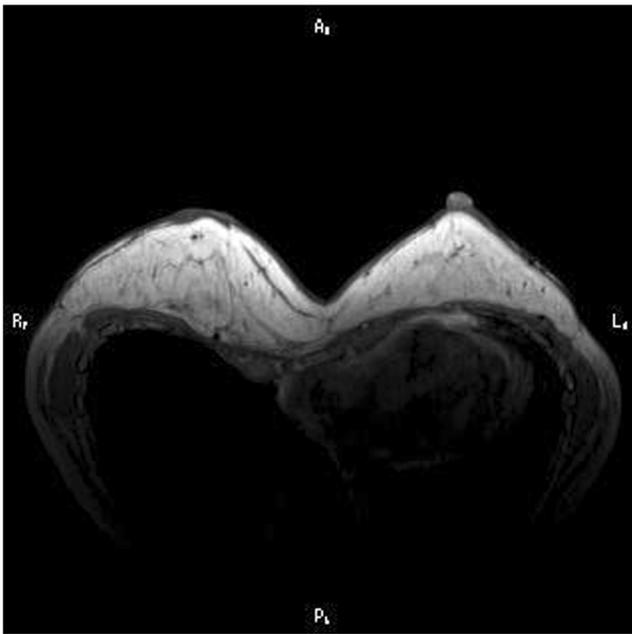


Fig. 4 Two years after the final fat grafting, the T1 axial view magnetic resonance image shows only small cysts and no other abnormal findings

was performed by Rudolph R [25], in which the chest wall depression was made flat with de-epithelialized transverse rectus abdominis musculocutaneous flap at first stage, followed by subpectoral implantation for delayed bilateral breast reconstruction. The other case was performed by Mishra et al. [26], in which the pectus excavatum was corrected by a customized sternal implant, and bilateral breast reconstruction was performed using both muscle-sparing latissimus dorsi flap and anatomical breast implant. The skeletal elevation was not indicated for these cases, since the Ravitch [2] and Nuss [3] were invasive procedures for both patients of over 50 years of age. They underwent sternal or breast implant placement for basal structure to correct pectus excavatum or bilateral breast reconstruction. To the best of our knowledge, immediate bilateral DIEP flap breast reconstruction with multistage fat grafting for pectus excavatum correction and breast augmentation has not been previously reported. Placing an

implant may complicate future implant displacement, capsular contracture, and visible contours, which may cause poor esthetic results. However, autologous tissues can provide natural breast and chest wall appearance with long-term stable esthetic results.

In our case, the anterior chest wall depression was filled with a well vascularized flap, which became an ideal recipient bed for the subsequent fat grafting [27, 28]. Patient's deformity was complex and extensive, and she also requested breast enhancement. Three fat grafting sessions were required to achieve these results and to overcome challenges posed by subcutaneous scarring and the dermis of patient's own abdominal skin on the superficial layer of buried DIEP flap, which hampered the penetration of the cannula. To overcome this, the tissue was infiltrated with an 18-gauge needle to release the firm dermal barrier in the first session. The transferred DIEP flap became the basal structure in the second procedure, which was effective for contour restoration and volume augmentation. The results demonstrated that this method can be considered as a complementary procedure for congenital and acquired complex chest wall deformities. Brava has been used during perioperative management of fat grafting into the breast as a means to increase recipient microcirculation and graft capacity [29, 30]. Because the baselines of both breasts were reconstructed after the initial surgery, this patient was able to wear Brava domes on both breasts. As a result, it allowed a large volume of fat averaging 324 ml to be grafted in the reconstructed breast with low interstitial pressure.

Conclusions

A bilateral breast cancer patient with pectus excavatum underwent immediate bilateral DIEP flap breast reconstruction followed by three complementary fat grafting sessions to correct reconstructed breasts and chest wall deformities. The flap surgery achieved satisfactory morphological and esthetic results in this elderly patient. The phased fat grafting was safe, and it not only corrected the breast cancer sequelae and pectus excavatum but also enhanced the breast esthetics.

Table 1 Previous surgical case reports of bilateral breast cancer with pectus excavatum

Authors	Age, years	Type of mastectomy	Timing of reconstruction	Breast reconstruction/pectus excavatum procedure	Complications
Rudolph [25] (1986)	61	MR	Delayed 2 stage	Breast implants (subpectoral)/unilateral TRAM flap	Bleeding, capsular contracture
Mishra et al. [26] (2011)	54	MR	Delayed 1 stage	Bilateral MS-LD flaps with breast implants/sternal implant (subpectoral, subrectus)	None
Our case	52	NSM	Immediate 1 stage	Bilateral DIEP flaps with multistage fat grafting	Pigmentation

MR, modified radical mastectomy; NSM, nipple-sparing mastectomy; TRAM, transverse rectus abdominis; MS-LD, Muscle-sparing latissimus dorsi; DIEP, deep inferior epigastric perforator

Compliance with ethical standards

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Conflict of interest Toshihiko Satake, Mayu Muto, Seiko Kou, Jun Sugawara, Kazutaka Narui, Shinji Kobayashi, Takashi Ishikawa and Jiro Maegawa declare that they have no conflicts of interest.

Ethical approval For this type of study formal consent is not required.

Informed consent Informed consent was obtained from the patient before her inclusion in this study.

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