

Video-Assisted Breast Surgery: Reconstruction after Resection of More than 33% of the Breast

Koji Yamashita^{1,2} and Kazuo Shimizu²

¹Department of Surgery, Nippon Medical School Musashi Kosugi Hospital

²Division of Endocrine Surgery, Department of Surgery, Nippon Medical School

Abstract

Background: Improvements in reconstructive mammoplasty methods have made it possible to resect more of the mammary gland while achieving good esthetic results in breast-conserving surgery. We report the esthetic results of extended wide resection of the breast with reconstruction procedures.

Methods: Breast-conserving surgery was performed using a video-assisted breast surgery (VABS) technique. Breast reconstruction was simultaneously performed using the following three methods: mobilization of the remnant mammary gland, transplantation of the lateral tissue flap, and filling with an absorbent synthetic fiber mesh or cotton. The cosmetic results were evaluated with an original five-item-by-four-step scoring system: ABNSW—assessing asymmetry, breast shape, nipple shape, skin condition, and wound scar.

Results: From December 2001 through March 2006, we performed endoscopic VABS in 130 patients with breast diseases. The candidates were 29 patients with breast cancer who required resection of more than 33% of the mammary gland because of ductal carcinoma in situ (1 patient), multiple cancers (6 patients), widely extended lesions (20 patients), and lesions after preoperative systemic therapy (2 patients). Twenty-one patients underwent resection of 33% to 50% of the breast, and 8 underwent resection of more than 50% of the breast. All surgical margins were negative on examination of permanent histological preparations. The original shape of the breast was preserved. There was no local recurrence after follow-up times of 33 months (maximum) and 19 months (average).

Conclusions: The newly devised reconstruction methods with VABS can markedly increase the mammary gland resection volume while achieving a good esthetic outcome, ensuring a precise disease-free surgical margin, and expanding the indications for breast-conserving therapy.

(J Nippon Med Sch 2006; 73: 320–327)

Key words: endoscopic surgery, breast-conserving therapy, breast reconstruction, cosmetic outcomes, breast cancer

Introduction

Breast-conserving surgery (BCS) is indicated for small, early breast cancers¹⁻³. However, even when disease is at an early stage, BCS is not recommended for multiple breast cancers, widely ductal-spread breast cancer, and ductal carcinoma in situ (DCIS), because of the need for wide resection of the breast⁴. An unattractive deformation will be result from wide excision, i.e., more than 30% of the total breast volume or 413.38 cm³ without reconstruction⁵⁻⁷. However, owing to advances in reconstruction methods, we are able to perform BCS while achieving a good esthetic outcome, even for patients who require resection of more than 50% of the breast.

We have devised a new endoscopic surgical procedure for breast disease named video-assisted breast surgery (VABS)⁸. It has three main features: working space is created with the retraction method, almost all surgical procedures are performed through a single small axillary incisional port, and the breast is reconstructed simultaneously to preserve the preoperative breast shape. This procedure can be used for various breast diseases, including large benign tumors and widely extended malignant disease without skin invasion. It is expected to improve the quality of life of patients with breast disease.

There are three types of breast reconstruction methods: mammary gland mobilization, transplantation of a lateral tissue flap (LTF), and filling with synthetic absorbent fiber mesh or cotton. We performed VABS for widely extended resections of the breast and achieved good esthetic results. This method will provide an incentive for patients with early breast cancer to undergo curative treatment. In this report, we present our surgical methods and the esthetic results of breast reconstruction using VABS.

Patients and Methods

Patients

From December 2001 through March 2006, 356

patients with breast disease were treated surgically at the Department of Surgery, Nippon Medical School Musashikosugi Hospital. Of these patients, 132 were selected as candidates for VABS according to the following criteria: 1) early breast cancer and benign breast disease without severe complications and 2) no tumor extension to the nipple or direct invasion to the skin (this was to preserve the nipple and the skin over the tumor).

Patients who had advanced cancer with axillary lymph node metastasis and those who had severe co-morbid conditions, such as heart disease, renal failure, liver dysfunction, and poor performance status, were excluded from the study. In two patients, VABS was converted to ordinary modified radical mastectomy due to diffuse ductal spread and direct skin invasion. VABS was, therefore, accomplished in 130 patients (**Table 1**).

Among the patients who underwent VABS, 29 required resection of more than 33% of the entire mammary gland because of wide ductal spread, multiple lesions, and other reasons (**Table 2**). Twenty-one patients underwent resection of 33% to 50% of the breast, and 8 underwent resection of more than 50% of the breast (**Table 3**).

Surgical Methods

The surgical VABS procedure has been described in detail elsewhere⁸. The operative procedures were as follows: skin incision, skin flap formation (tunnel method⁹), pectoral muscle fascia dissection, vertical section of the mammary gland, sentinel lymph-node biopsy by the dye-staining method guided by preoperative three-dimensional computed tomographic (3D-CT) lymphography marking¹⁰⁻¹², and axillary lymph-node dissection (levels I and II). Radiotherapy and chemotherapy were performed for malignant disease.

Breast reconstruction was simultaneously performed using the following three procedures: mobilization of the remnant mammary gland, filling of the thoracic fat LTF, and filling with an absorbent synthetic fiber. The mobilization serves to separate the tissue around the mammary gland and to suture the cut edges of the gland to close the defect space. The filling of the LTF serves to transplant fat tissue

Table 1 Operative Methods

Procedures	Case
Extirpation	8
Wide excision	10
Lumpectomy + Ax	108
Skin-sparing total mastectomy	4
VABS Total	130
Switch to MRM	2
Sentinel LN biopsy	88

Ax: Axillary lymph node dissection (level I+II)
 MRM: modified radical mastectomy
 LN: lymph node

Table 2 Extended Wide Resection

Diseases	Resection 33 ~ 50%	Volume 50% <	Total
DCIS	0	1	1
Multiple lesions	2	4	6
Widely extended	18	2	20
Post-PST	1	1	2
Total	21	8	29

DCIS: Ductal carcinoma in situ
 PST: Preoperative systemic therapy

in the lateral part of the chest while preserving a feeding vessel of the lateral thoracic artery¹³. The absorbent synthetic fiber filling was either a polyglycolic acid mesh (Dexon mesh, 18 × 23 cm, Tyco Healthcare Japan Inc., Tokyo), proposed by Dr. Fukuma of Kameda General Hospital as an filling of solid mass method for filling the affected part of the gland¹⁴⁻¹⁶, or oxidized cellulose cotton (Surgical Absorbable Hemostat-cotton, Johnson & Johnson KK, Tokyo), which was proposed by Dr. Yamagata of Nippon University^{17,18}. The method was selected on the basis of tumor location and the volume of resection (details are described in the results).

To detect local recurrence after surgery, ultrasonography was performed every 3 months, and breast magnetic resonance was performed every 6 months. All patients with cancer had received 50 Gy of radiotherapy (+10 Gy for boost), hormone therapy (tamoxifen and goserelin for premenopausal patients; anastrozol and toremifene for postmenopausal patients), and chemotherapy (anthracyclin + cyclophosphamide or a taxane or both) in accordance with St. Gallen's

Table 3 Relationship between resection volume and reconstruction methods

Resection Volume (%)	Mobilization	LTF Filling	Fiber Filling	Total
<25	28	16	3	47
25 ≤ < 33	17	18	7	42
33 ≤ < 50	1	13	7	21
50 ≤	0	4	4	8
Total	46	51	21	118

LTF: lateral tissue flap

recommendation¹⁹.

Preoperative Systemic Therapy

Preoperative systemic therapy (PST) was given by chemotherapy to patients with axillary lymph node metastasis or with a tumor larger than 3 cm in diameter. The PST protocol was anthracyclin + cyclophosphamide for 4 cycles and weekly paclitaxel for 4 cycles.

Cosmetic Evaluation, Patient Satisfaction, and Informed Consent

All patients were examined and questioned about their satisfaction with the esthetic results every 6 months after surgery. We devised a scoring system using the five-item-by-four-step method (ABNSW)²⁰ for evaluating cosmetic outcomes. The scoring system consists of five items: asymmetry (A), breast shape (B), nipple shape (N), skin condition (S), and wound scar (W). Each item is evaluated with four steps (0: poor, 1: fair, 2: good, and 3: excellent). These scores are then totaled. On a scale of 15 points, the results were defined as follows: 15, excellent; 11 to 14, good; 6 to 10, fair; and <5, poor. Photographs of the breasts of all patients were taken from 8 angles every 6 months. Patient satisfaction was evaluated using the scores of the QOL-ACD-B questionnaire²¹.

Informed consent for this operative procedure was obtained from all patients before surgery.

Results

Of the 130 patients who underwent VABS, 112 had malignant disease and 18 had benign disease. The selected operative methods are shown in **Table**

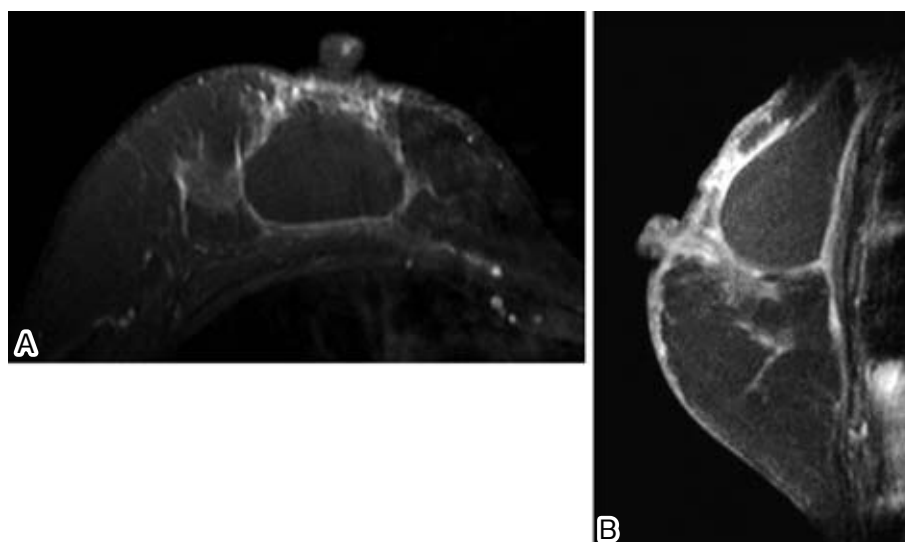


Fig. 1 Contrast-enhanced subtracted breast magnetic resonance images in axial (A) and sagittal (B) planes show capsule wall-like contrast enhancement surrounding the homogenous nonenhanced mass, which is thought to be filling content.

Table 4 Relationship between tumor location sites and reconstruction methods

Sites	Mobilization		LTF filling		Absorbable fiber	
	No	%	No	%	No	%
A	13	28.3	13	25.5	6	28.6
B	4	8.7	7	13.7	3	14.3
C	24	52.2	19	37.3	8	38.1
D	3	6.5	11	21.6	4	19.0
E	2	4.3	1	2.0	0	0
Total	46		51		21	

LTF: lateral tissue flap

Table 5 Aesthetic results and resection volume

ABNSW score	Resection 33 ~ 50%	Volume 50% <	Total
10	0	1	1
11	0	0	0
12	3	1	4
13	3	2	5
14	4	0	4
15	11	4	15
Total	21	8	29

1. Extirpation was performed for benign diseases. A wide excision was created in patients in whom malignancy was suspected. Lumpectomy with axillary lymph-node dissection at levels I and II was performed for 108 patients with breast cancer. The maximum volume of resection was 70% of the entire gland. Skin-sparing total mastectomy was performed in 4 patients with widespread DCIS. One patient underwent simultaneous reconstruction with a silicon gel prosthesis. Sentinel lymph-node biopsy was performed in 88 patients. Of these patients, 47 underwent 3D-CT lymphography. Breast reconstruction was performed for 118 patients, including 6 patients with benign disease.

Magnetic resonance images obtained 6 months after the operation showed the details of the breast

construction with the filled content. The absorbable fiber mesh or cotton fills the defective part of the gland to keep the original breast shape. The filling takes the form of the space. The filling melted with exudate and was absorbed to become a solid fibrous-tissue mass surrounded by a granulated capsule wall (Fig. 1). For about 3 months after the operation, the exudate collects in the space and makes the reconstructed breast larger than the healthy breast. However, after 3 months, the exudate is absorbed and decreases so that the breast assumes its original shape. Therefore, it is better not to puncture the collected fluid. The breast shape will be stable 6 months after the operation, and the esthetic outcome should be good.

The location of the tumor affects the postoperative breast shape. The relationships

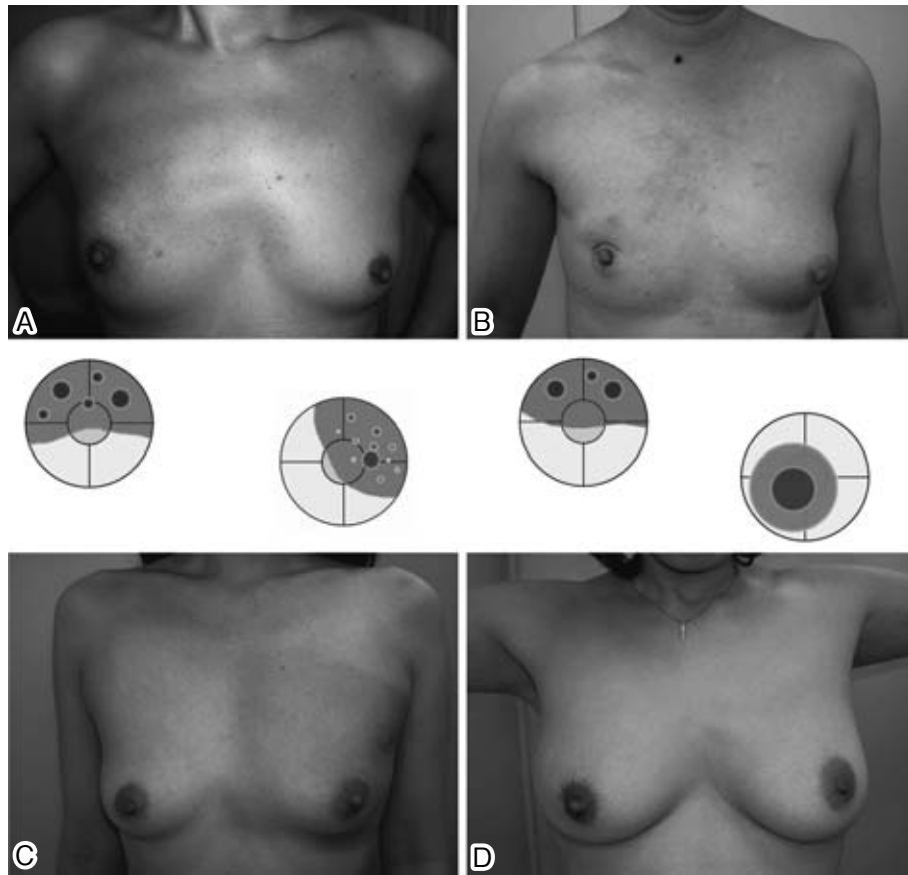


Fig. 2 Photographs of the reconstructed breasts 6 months after the operation.
A: right AC area, multiple, mucinous carcinoma, p-T1N0M0, stage I, 60% resection, LTF filling (100 ml), ABNSW: 3, 3, 3, 3=15
B: right AC area, multiple, papillotubular carcinoma, p-T1N0M0, stage I, 50% resection, cotton filling (4 sheets), ABNSW: 2, 3, 2, 3, 3=13
C: left C area, 1.6 cm, DCIS, p-T0N0M0, stage 0, 50% resection, mesh and cotton filling (5 sheets), ABNSW: 3, 3, 3, 3, 3=15
D: right DE area, 3 cm, solid-tubular carcinoma, p-T1N0M0, stage I, 50% resection, LTF filling (125 ml), ABNSW: 3, 3, 3, 3, 3=15

between the tumor location and reconstruction methods are shown in **Table 4**. We chose the best method of reconstruction for each patient. When the tumor is in the caudal side B and D area of the breast, the volume defect cannot be compensated for by gland mobilization and the breast is strongly deformed with loss of the proper inframammary line. Therefore, filling should be performed with LTF or absorbable fibers.

The resected volume of the gland is another important factor in maintaining breast shape. The relationships between resected volume and reconstruction methods are shown in **Table 3**. When more than 30% of the breast was resected, filling with LTF or absorbable fibers is needed. At most,

60% of the breast can be resected without severe deformation. We prefer to use absorbable fibers in patients with a small LTF volume or with preservation of axillary lymph nodes after sentinel lymph-node biopsy.

The original ABNSW scoring system shows the esthetic results of the extended wide resection of the breast (**Table 5**). The ABNSW score was more than 13 points in 83% of patients. This result implies that good esthetic results can be obtained even after extended wide resection. However, 1 patient had discharge of fluid through the skin incisional wound, and another had a hypersensitivity reaction to the filling content, which was consequently removed.

In **Figure 2**, we present four cases of esthetic

outcomes of breast reconstruction after resection of 50% or more than 50% of the breast. Patient **A** underwent resection of 60% of the breast for multiple mucinous carcinoma in the right AC area. The breast was reconstructed using LTF filling (100 ml). Patient **B** underwent resection of 50% of the breast for multiple papillotubular carcinoma in the right AC area. The breast was reconstructed using cotton filling (4 sheets). Patient **C** underwent resection of 50% of the breast for DCIS in the left C area. The breast was reconstructed using cotton filling (5 sheets). Patient **D** underwent resection of 50% of the breast for large solid-tubular carcinoma with ductal spread in the right DE area. The breast was reconstructed using LTF filling (125 ml). The ABNSW scores in patients **A**, **B**, **C**, and **D** were 15, 13, 15, and 15 points, respectively. Regardless of the volume of resection, we obtained good esthetic results.

The diseases that require an extended wide resection are listed in **Table 2**: DCIS, multiple lesions, and widely extended lesions. Particularly after PST, the original tumor area must be removed because of the scattered cancer cells remaining after PST. VABS and reconstruction methods can make such cases eligible for BCS.

The surgical margin, as observed with permanent histological sections, was negative within 5 mm from the stump. No locoregional recurrence was observed on follow-up examination for up to 36 months (mean, 19 months).

Discussion

Breast reconstruction after BCS has been performed by mobilization of the gland with wide dissection under the skin. Furthermore, endoscopic surgery requires a larger operating space. However, wider dissection of the gland damages essential breast architecture and causes distortion. Gland mobilization cannot compensate for volume loss; in particular, loss of the gland in areas B and D causes much distortion. Important factors in maintaining the original breast shape are to dissect the minimum area of mammary gland and not to exceed the resection area. The defect space should be filled

with contents such as LTF or absorbable cotton fibers or mesh, not with the surrounding gland or fat tissue. Muscle flaps of any type are not recommended, because they can damage other parts of the body and decrease quality of life.

The postoperative course of the VABS BCS using the filling methods was slightly different from that using the standard method. The exudate collecting in the defect space makes the breast swell and become larger than the other breast, but the swelling gradually decreases over 3 months and the breast becomes a suitable size. For this reason, there should be no puncturing to remove the collecting fluid in the breast. Some fluid discharged from the sutured wound of one patient, whose breast became smaller and deformed. Her ABNSW score was 10 (**Table 5**). Wounds should be firmly closed by suturing 3 layers under the skin. There were temporary hypersensitivity reactions in 2 patients; the reaction resolved spontaneously in 1 patient but worsened in the other patient, necessitating removal of the filling.

Filling with LTF and absorbable fibers make it possible to excise more than 50% of the mammary gland without severe deformation while achieving a good esthetic outcome. Wide excision can remove enough of the gland to secure a surgical margin against cancer cell invasion and ductal spread. We have performed resections of more than 33% of the breast in patients who required additional wide resections because of cancer cells in the surgical margin shown by the intraoperative histological examination of fast-frozen sections, and thus avoided several mastectomies.

The criteria for BCT in the guidelines of the Japanese Breast Cancer Society (2005) are as follows: (1) tumor size is 3 cm or less, (2) image diagnosis indicates no sign of extensive intraductal spread, (3) no multiple tumors, (4) radiation therapy is possible, and (5) patient wants to receive BCT²². However, from the indications of our breast reconstruction using VABS, these restrictions can be reduced because the original breast shape can be retained even if a large volume of the breast might have to be removed. The extended wide excision of BCS using filling reconstruction methods can expand its

indication to DCIS, multiple lesions, and widely extended diseases with ductal spread, as well as the shrunken carcinoma after PST.

Small but multiple lesions require extrawide resections of the breast, because all lesions require the same free surgical margin of 1 or 2 cm from each tumor edge. Small, early cancer with extensive ductal spread also requires extrawide resections. We performed this operation on 6 patients with multiple lesions and 20 patients with widely extended lesions with ductal spread of carcinoma.

Diffuse DCIS is an early breast cancer, but it spreads to a wide area of the mammary gland and usually requires mastectomy. Skin-sparing total mastectomy has become standard therapy²³. Diffuse DCIS is also a good candidate for VABS²⁴. We performed VABS skin-sparing total mastectomy in 4 patients and VABS to resect more than 50% of the breast in 1 patient.

In patients with advanced breast cancer, PST offers a chance to preserve the breast, but the original tumor area must be removed because of the many scattered residual cancer cell nests left alive there after PST unless a pathological complete response is achieved. VABS and reconstruction methods can make such cases eligible for BCS. We performed VABS BCS in two patients after PST.

The cosmetic results and patient satisfaction were very good and justified the time and effort spent to perform VABS. As the induration due to postoperative inflammation become softer with time, cosmetic results and patient satisfaction improve. The early postoperative complications were less severe than with conventional surgery. Locoregional recurrence was not observed. However, strict follow-up is needed. We can confidently state that this operation is adequate as a breast cancer therapy, and we are now improving our methods of breast reconstruction to improve outcomes further.

The newly devised reconstruction methods using VABS can markedly increase the volume of mammary gland resection while achieving a good esthetic outcome, allows a precise free surgical margin, and expands the indications for BCT.

Acknowledgments: We thank Mina Takushima, Shuji

Haraguchi, Masafumi Hioki, and the staff at the Department of Surgery, Nippon Medical School Musashikosugi Hospital, for their invaluable assistance.

References

1. Fisher B, Redmond C, Poisson R, et al: Eight-year results of a randomized clinical trial comparing total mastectomy and lumpectomy with or without irradiation in the treatment of breast cancer. *N Eng J Med* 1989; 320: 822-828.
2. NIH Consensus Conference: Treatment of early stage breast cancer. *JAMA* 1991; 265: 391-395.
3. Wood AJ: Treatment of breast cancer. *N Engl J Med* 1998; 339: 974-983.
4. Guidelines preparation subcommittee of Learning Committee of Japanese Breast Cancer Society: Guideline of Breast Conservative Therapy. *Jpn J Breast Cancer* 1999; 15: 147-156.
5. Yamagata M: Breast Cancer. *Gan To Kagaku Ryoho* 2004; 10: 1506-1510.
6. Fedorcik GG, Sachs R, Goldfarb MA: Oncologic and esthetic results following breast-conserving therapy with 0.5 cm margins in 100 consecutive patients. *Breast J* 2006; 12: 208-211.
7. Curran D, VanDongen JP, Aaronson NK, et al: Quality of life of early-stage breast cancer patients treated with radical mastectomy or breast-conserving procedures: results of EORTC trial 10801. *Eur J Cancer* 1998; 34: 307-314.
8. Yamashita K, Shimizu K: Endoscopic video-assisted breast surgery: procedures and short-term results. *J Nippon Med Sch* 2006; 73: 200.
9. Yamagata M, Takasugi T, Takayama T: Partial mastectomy by the periareolar incision. *Geka Chiryō* 2002; 86: 932-940.
10. Suga K, Ogasawara N, Okada M, et al: Interstitial CT lymphography-guided localization of breast sentinel lymph node: preliminary results. *Surgery* 2003; 133: 170-179.
11. Tangoku A, Yamamoto S, et al: Sentinel lymph node biopsy using computed tomography-lymphography in patients with breast cancer. *Surgery* 2004; 135: 258-265.
12. Minato M, Hirose C, Sasa M, et al: 3-Dimensional computed tomography lymphography-guided identification of sentinel lymph node in breast cancer patients using subcutaneous injection of nonionic contrast medium. A clinical trial. *J Comput Assist Tomogr* 2004; 28: 46-51.
13. Ohuchi N, Harada Y, Ishida T, et al: Breast conserving surgery for primary breast cancer: Immediate volume replacement using lateral tissue flap. *Breast Cancer* 1997; 4: 59-65.
14. Sanuki J, Higa K, Wadamori K, Fukuma E: Filling method to defect part of mammary gland after breast-conserving therapy by using polyglycol mesh. *J Jpn Surg Soc* 2003; 104: 243.
15. Sanuki J, Fukuma E, Wada K, Higa K, Sakamoto M, Tsunoda Y: A device for improving esthetic outcomes after breast conserving surgery. *Jpn J Breast Cancer* 2003; 18: 486-487.

16. Sanuki J, Fukuma E, Wadamori K, Higa K, Sakamoto N, Tsunoda Y: Volume replacement with polyglycolic acid mesh for correcting breast deformity after endoscopic conservative surgery. *Clin Breast Cancer* 2005; 6: 175.
17. Yamagata M: Endoscopic breast conserving surgery. *J Clin Surg* 2005; 60: 1481-1490.
18. Yamagata M: Breast Cancer. *Gan To Kagaku Ryoho* 2004; 10: 1506-1510.
19. Goldhirsch A, Wood WC, Gelber RD, Coates AS, Thurlimann B, Senn HJ: Meeting Highlights: Updated International Expert Consensus on Primary Therapy of Early Breast Cancer. *JCO* 2003; 21: 3357-3365.
20. Yamashita K: Cosmetic assessment. *J Jpn Soc Endosc Surg* 2005; 10: 165-170.
21. Okamoto T, Shimosuma K, Katsumata N, et al.: Measuring quality of life in patients with breast cancer: a systematic review of reliable and valid instruments available in Japan. *Breast Cancer* 2003; 10: 204-213.
22. The research group of the implementation guidance of the standard breast conserving therapy: In *Breast conserving therapy guideline, 2005*; Kanehara & Co. LTD., Tokyo.
23. Cheung KL, Blamey RW, Robertson JFR, Elston CW, Ellis IO: Subcutaneous mastectomy for primary breast cancer and ductal carcinoma in situ. *Eur J Surg Oncol* 1997; 23: 343-347.
24. Ho WS, Ying SY, Chan AC: Endoscopic-assisted subcutaneous mastectomy and axillary dissection with immediate mammary prosthesis reconstruction for early breast cancer. *Surg Endosc* 2002; 16: 302-306.

(Received, July 19, 2006)

(Accepted, October 25, 2006)