

Quality of Life in Palliative Post-mastectomy Reconstruction: Keystone versus Rotational Flap

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Background: Late stage breast cancer presents with malignant wound causing skin infiltration, pain, bleeding, and malodour, which affect quality of life (QoL). Palliative mastectomy aims to eliminate wound symptoms and requires prolonged wound care to improve QoL. This study aimed to prospectively investigate QoL differences in 2 alternative reconstructive methods: keystone flap and rotational flap.

Methods: Twenty-four late stage breast cancer patients with symptoms of cancer wounds were included in this study. They were divided into 2 groups: keystone flap and rotational flap. Each patient's QoL was evaluated using EORTC QLQ-C30 and QLQ-BR23 before and 3 weeks after surgery.

Results: Global health post-surgery was significantly improved compared with pre-surgery in all patients ($P < 0.001$), across both the keystone ($P = 0.018$) and rotational groups ($P = 0.007$). Breast symptoms post-surgery were also improved compared with pre-surgery in all patients ($P = 0.035$). However, when analyzed per group, breast symptoms were only improved significantly in the keystone group ($P = 0.013$) but not in the rotational group ($P = 0.575$). When compared between 2 groups, future perspective post-surgery in the keystone group [100 (0–100)] was better than the rotational group [66.7 (0–100)], ($P = 0.020$).

Conclusions: Reconstructive surgery after mastectomy improves QoL in late stage breast cancer patients. The keystone flap is superior to the rotational flap in improving global health and breast symptoms. (*Plast Reconstr Surg Glob Open* 2021;9:e3457; doi: [10.1097/GOX.0000000000003457](https://doi.org/10.1097/GOX.0000000000003457); Published online 15 March 2021.)

INTRODUCTION

Breast cancer is the most common cancer in women worldwide.¹ In developing countries such as Indonesia, it is usually diagnosed at later stages. Based on Dharmais National Cancer Hospital registry from 2011 to 2013, 70% of new breast cancer patients were already in stage III–IV.² This results in poorer prognosis and a higher mortality rate.³ Late stage breast cancer also presents with malignant wound(s), causing skin infiltration, pain, bleeding, exudation, and malodour, which affect the patient's quality of life (QoL).⁴

Treatment for late stage breast cancer is focused on palliative care through a multimodal approach of surgery, chemotherapy, and radiotherapy. Due to limited availability and high risk, surgery may not be chosen and patients may be burdened with prolonged routine local wound care. Palliative mastectomy aims to eliminate wound symptoms and the necessity of prolonged wound care to improve QoL.⁴ QoL has been used as a treatment parameter for breast cancer.⁵

The choice for breast reconstruction method is based on reconstructive elevator theory, which has replaced the conventional reconstructive ladder. Free flap is commonly chosen to close defects from extensive excision. However, local flap is still considered an ideal option for reconstructing mastectomy defects.⁶ Local flap reconstruction requires minimal operative time, provides better local-like tissue, and involve less risks and complications compared with the free tissue transfer. Failure of free flap can cause total loss of all transferred tissue and lead to the need for another reconstruction.

Two local flaps that can be used are the keystone and rotational flaps. The keystone design perforator island flap is a local flap that has become the common option for reconstruction, especially for large defects in the trunk.⁷ Introduced in 2003, the keystone design perforator island

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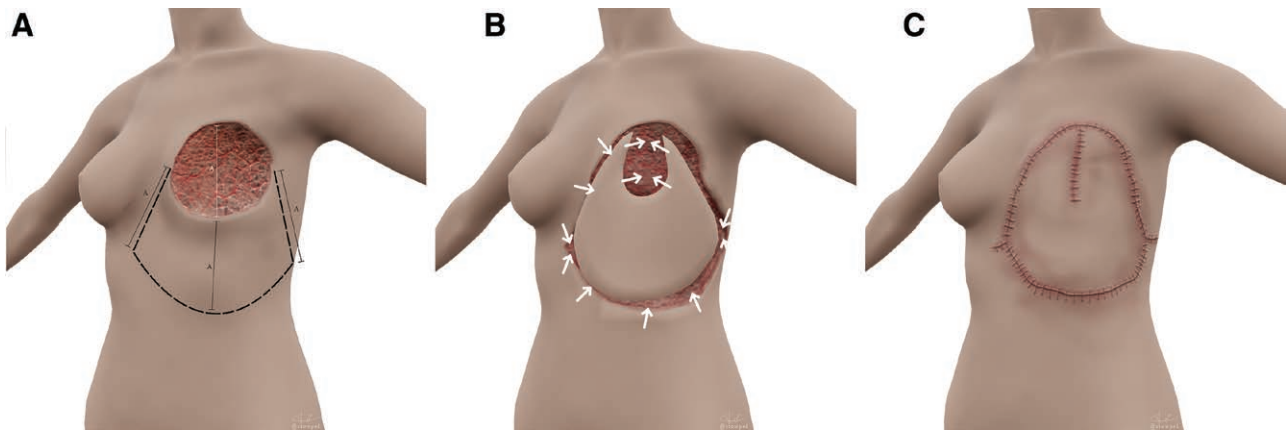


Fig. 1. Procedure for keystone flap reconstruction. A, Harvesting phase. B, Insetting phase. C, Result.

flap or keystone flap is a multiperforator advancement flap consisting of 2 conjoint V-Y island flaps.⁸ The rotational advancement flap can also be used for breast reconstruction after mastectomy.⁹

To date, no previous studies have compared QoL between 2 local flaps used as the reconstruction method post-mastectomy. This study aimed to prospectively investigate QoL differences in 2 alternative reconstructive methods: keystone flap and rotational flap.

METHODS

Subjects and Study Design

The study was conducted in Dharmais National Cancer Hospital from August 2018 to May 2019. The inclusion criteria were patients who (1) were 30- to 65-year-old women; (2) were diagnosed with late stage breast cancer with at least T3 primary tumor and/or skin infiltration (T4b/T4c), with or without distant metastasis (stage IIB, IIIB, IIIC, or IV); (3) had received neoadjuvant chemotherapy; (4) underwent post-mastectomy reconstruction by a plastic surgeon. There were 24 patients included in this study. We prospectively studied the patients.

Intervention

All patients underwent post-mastectomy reconstruction by the same plastic surgeon to close the extensive chest wall defect. There were 2 type of flaps used for reconstruction: keystone flap and rotational flap. Patients were allocated in treatment group using the consecutive method. A skin graft was also used for closure in addition to flap if the defect was too extensive. Both groups had the same postoperative wound care.

The procedure for keystone flap reconstruction is divided into design, harvesting, and inseting phases. The design used is omega or fish mouth variant. In the harvesting phase, skin incision is performed with a ratio of 1:1 to defect area, continued with blunt dissection on subcutaneous area, and release of flap from the surrounding tissue. Deep fascia on both convex sides of the flap can be released if needed. Because it is a multiperforator flap, no specific vascular pedicle needs to be determined. In the inseting phase, the flap is moved by advancement or

transposition to close defect, sutured from center to edge by ensuring free tension, and a drainage tube is inserted in the inferior part of defect¹⁰ (Fig. 1).

Rotational flap relies on a pivot point to create a semi-circular skin cover. The design is drawn similar to arc of a circle, with the arc directed to area of tissue redundancy. Incision was made according to design, while also carefully preserving the chosen pedicle.¹¹

Outcome Measurement

QoL was evaluated using European Organization for Research and Treatment (EORTC) Quality of Life, Questionnaire-Core 30-questions (QLQ-C30) and Quality of Life, Questionnaire-Breast Cancer-23-questions (QLQ-BR23). It was measured before and 3 weeks after the surgery. Three weeks cut-off was chosen because local healing process is already in remodeling phase and to focus on QoL after surgery, not the general condition of cancer. The QoL score ranges from 0 to 100. For functional scale, higher score or closer to 100 means better QoL. For symptom scale, lower score or closer to 0 means worse QoL.

Statistical Analysis

Distribution of data was analyzed using the Shapiro Wilk test. Comparison of QoL before and after surgery in all samples for each group were analyzed using the Wilcoxon test. Meanwhile, comparison of QoL between 2 groups before surgery or after surgery were analyzed using the Mann-Whitney test. Degree of significance was set at $P < 0.05$, and statistical analysis was performed using SPSS (version 26.0).

RESULTS

There were 12 subjects in each group. The difference of characteristics between 2 groups is presented in Table 1. There was no significant difference between 2 groups. The smallest defect area was 150 cm², and the largest was 1584 cm² (Table 1).

All reconstructive surgeries were successful with no reoperation. Three subjects also required a skin graft due to limited flap coverage. The process of each flap from malignant wound to 3 weeks post-surgery is shown in Figs. 2 and 3.

Table 1. Patient Characteristics

Characteristics	Value		P
	Keystone (n = 12)	Rotational (n = 12)	
Age (y)	47.50 (35.00–60.00)	52.50 (34.00–64.00)	0.435
BMI (kg/m ²)	24.14 (17.07–27.77)	23.59 (16.02–34.22)	0.795
Low BMI			
Yes	2 (16.7%)	3 (25%)	1.000
No	10 (83.3%)	9 (75%)	
Obesity			
Yes	5 (41.7%)	5 (41.7%)	1.000
No	7 (58.3%)	7 (58.3%)	
Side			
Unilateral	10 (83.3%)	11 (91.7%)	1.000
Bilateral	2 (16.7%)	1 (8.3%)	
Metastasis			
Yes	3 (25%)	5 (41.7%)	0.667
No	9 (75%)	7 (58.3%)	
Defect size (cm ²)	541 (180–1584)	506 (150–1240)	0.686

In all subjects, global health after surgery was significantly better ($P < 0.001$) than before surgery, from 58.33 (41.67–83.33) to 83.33 (41.67–91.67). Meanwhile, physical and role functioning were significantly lower after surgery compared with before surgery ($P = 0.016, 0.007$). Breast symptoms were better after surgery ($P = 0.035$), from 25 (0–91.67) to 16.67 (0–50). Meanwhile, arm symptoms were worse after surgery ($P < 0.001$), from 11.11 (0–77.78) to 33.33 (0–88.89). This comparison is shown in [Table 2](#).

Comparison of QoL before and after surgery in the keystone group is shown in [Table 3](#). Global health after surgery was significantly better ($P = 0.018$) from 62.50 (41.67–83.33) to 83.33 (41.67–91.67). There was improvement in breast symptoms, from 25 (0–91.67) to 12.5 (8.33–25) with $P = 0.013$. Meanwhile, arm symptoms became worse from 11.11 (0–77.78) to 38.89 (11.11–88.89) with $P = 0.004$ ([Table 3](#)).



Fig. 2. Keystone flap process. A, Breast cancer malignant wound. B, Flap design on post-mastectomy defect (note the double keystone design). C, Insetting phase. D, Direct post-reconstruction result. E, Three weeks post-reconstruction.



Fig. 3. Rotational flap process. A, Breast cancer malignant wound. B, Flap design on post-mastectomy defect. C, Insetting phase. D, Direct post-reconstruction result. E, Three weeks post-reconstruction.

Comparison of QoL before and after surgery in the keystone group is shown in Table 4. Global health after surgery was also significantly better ($P=0.007$) from 54.17 (41.67–83.33) to 83.33 (58.33–91.67). Meanwhile, role functioning and arm symptoms became worse after surgery from 100 (50–100) to 66.67 (0–100) and from 11.11 (0–77.78) to 27.78 (0–88.89) consecutively ($P=0.017, 0.047$).

The difference in QoL between 2 groups was analyzed before surgery (Table 5) and after surgery (Table 6). There was no significant difference in the QoL between the 2 groups before surgery. However, after surgery, the keystone group had better future perspective compared with the rotational group ($P=0.020$) (Tables 5 and 6).

DISCUSSION

The keystone flap has a robust vascularization because it is rich in perforators. Without the need to specify pedicle, it is a simple technique with short surgical time. It relies on skin laxity to ensure tension-free closure. The rotational flap is well known as one of the most basic local flaps with its simple design. Good vascularization is critical to flap success, which in turn affects patients' QoL.

In this study, the global health of patients undergoing reconstruction was significantly better after surgery in all

subjects and each group. This proves that palliative mastectomy, although not curative, is meaningful for patients. Global health status in patients who were reconstructed with keystone flap and rotational flap was 83.33 (41.67–91.67) and 83.33 (58.33–91.67) respectively with no statistically significant difference.

A preliminary study found that global health using keystone flap reached 66.7 (41.7–91.7).¹² This result difference might be due to discrepancy in data collection time. In this study, data were taken on 21st day after surgery, whereas in the preliminary study, they were taken with no standardized time at 1 month to 2 years after surgery. This allowed intervention from other factors that influence QoL outcomes aside from mastectomy surgery.

In Croatia, QoL of breast cancer patients was assessed 1 month post-mastectomy, which is not much different from this study. The QoL for global health in the study was lower than this study at 50 (33.3–53.3). Meanwhile, 1 year after surgery, global health did not change much at 50 (50–66).¹³ In Spain, the global health outcome of breast cancer patients 1 year after undergoing mastectomy was 66.67.¹⁴ In another study by Aerts et al, QoL at 6 months post-mastectomy was 62.35 ± 17.83 in patients with early stage breast

Table 2. Quality of Life of All Subjects

Scales	Median (Min–Max)		P
	Before Surgery	After Surgery	
QLQ-C30			
Functional scale			
Global health	58.33 (41.67–83.33)	83.33 (41.67–91.67)	<0.001
Physical functioning	90.00 (40–100)	73.33 (13.33–100)	0.016
Role functioning	100 (33.33–100)	66.67 (0–100)	0.007
Emotional functioning	91.67 (41.67–100)	91.67 (33.33–100)	0.308
Cognitive functioning	100 (50–100)	100 (50–100)	0.204
Social functioning	100 (33.33–100)	100 (66.67–100)	0.340
Symptom scale			
Fatigue	22.22 (0–77.78)	22.22 (0–88.89)	0.917
Nausea and vomiting	0 (0–100)	0 (0–33.33)	0.024
Pain	25.00 (0–100)	33.33 (0–100)	0.021
Dyspnea	0 (0–33.33)	0 (0–66.67)	0.157
Insomnia	0 (0–100)	0 (0–100)	0.572
Appetite loss	0 (0–100)	0 (0–66.67)	0.044
Constipation	0 (0–100)	0 (0–100)	0.317
Diarrhea	0 (0–66.67)	0 (0–0)	0.180
Financial difficulties	33.33 (0–100)	33.33 (0–100)	0.719
QLQ-BR23			
Functional scale			
Body image	87.50 (33.33–100)	83.33 (0–100)	0.913
Sexual functioning	0 (0–66.67)	0 (0–50)	0.230
Sexual enjoyment	33.33 (33–67)	50 (0–67)	0.317
Future perspective	83.34 (0–100)	66.67 (0–100)	0.678
Symptom scale			
Systemic therapy side effects	23.81 (4.76–57.14)	11.91 (0–47.62)	<0.001
Breast symptoms	25 (0–91.67)	16.67 (0–50)	0.035
Arm symptoms	11.11 (0–77.78)	33.33 (0–88.89)	<0.001
Upset by hair loss	16.67 (0–100)	0 (0–33.33)	0.180

Table 3. Quality of Life of Keystone Group

Scales	Median (Min–Max)		P
	Before Surgery	After Surgery	
QLQ-C30			
Functional scale			
Global health	62.50 (41.67–83.33)	83.33 (41.67–91.67)	0.018
Physical functioning	90.00 (53.33–100)	73.33 (26.67–100)	0.073
Role functioning	100 (33.33–100)	66.67 (0–100)	0.105
Emotional functioning	91.67 (41.67–100)	91.67 (33.33–100)	0.877
Cognitive functioning	83.33 (83.33–100)	100 (66.67–100)	0.125
Social functioning	100 (33.33–100)	100 (83.33–100)	0.262
Symptom scale			
Fatigue	27.78 (0–55.56)	22.22 (0–55.56)	0.829
Nausea and vomiting	8.34 (0–100)	0 (0–33.33)	0.078
Pain	33.33 (0–100)	33.33 (16.67–100)	0.049
Dyspnea	0 (0–33.33)	0 (0–33.33)	0.083
Insomnia	16.67 (0–100)	0 (0–100)	0.416
Appetite loss	33.33 (0–100)	0 (0–66.67)	0.143
Constipation	0 (0–100)	0 (0–66.67)	0.102
Diarrhea	0 (0–66.67)	0 (0–0)	0.317
Financial difficulties	33.33 (0–100)	16.66 (0–100)	0.197
QLQ-BR23			
Functional scale			
Body image	91.67 (41.67–100)	87.5 (0–100)	0.513
Sexual functioning	8.34 (0–66.67)	8.34 (0–50)	1
Sexual enjoyment	33.33 (33.33–66.67)	50 (33.33–66.67)	—
Future perspective	100 (33.33–100)	100 (0–100)	0.916
Symptom scale			
Systemic therapy side effects	30.95 (4.76–47.62)	14.29 (0–42.86)	0.010
Breast symptoms	25 (0–91.67)	12.5 (8.33–25)	0.013
Arm symptoms	11.11 (0–77.78)	38.89 (11.11–88.89)	0.004
Upset by hair loss	0 (0–100)	0 (0–0)	0.317

cancer.¹⁵ These differences may be due to differences in post-mastectomy reconstruction methods, patient factor, or time of data collection.

In the keystone group, breast symptoms were improved from 25 (0–91.67) to 12.5 (8.33–25). These include patient complaints about breasts such as pain, swelling,

sensitivity, and skin issues. A study in Croatia found worse breast symptoms, with a value of 33.33 (25–50), 1 month after surgery, and improved to 16.67 (16.7–25) in 1 year after surgery.¹³ Aerts et al found the mean score at 6 months post-mastectomy in early breast cancer patients was worse with 22.47 ± 17.54.¹⁵

Table 4. Quality of Life of Rotational Group

Scales	Median (Min–Max)		P
	Before Surgery	After Surgery	
QLQ-C30			
Functional scale			
Global health	54.17 (41.67–83.33)	83.33 (58.33–91.67)	0.007
Physical functioning	90.00 (40–100)	73.33 (13.33–100)	0.122
Role functioning	100 (50–100)	66.67 (0–100)	0.017
Emotional functioning	87.50 (41.67–100)	91.67 (41.67–100)	0.111
Cognitive functioning	100 (50–100)	100 (50–100)	0.785
Social functioning	100 (66.67–100)	100 (66.67–100)	1
Symptom scale			
Fatigue	22.22 (0–77.78)	27.76 (0–88.89)	0.944
Nausea and vomiting	0 (0–100)	0 (0–16.67)	0.144
Pain	16.67 (0–100)	16.67 (0–100)	0.257
Dyspnea	0 (0–33.33)	0 (0–66.67)	0.655
Insomnia	0 (0–100)	0 (0–100)	1
Appetite loss	0 (0–100)	0 (0–66.67)	0.083
Constipation	0 (0–100)	0 (0–100)	0.564
Diarrhea	0 (0–33.33)	0 (0–0)	0.317
Financial difficulties	33.33 (0–100)	33.33 (0–100)	0.598
QLQ-BR23			
Functional scale			
Body image	83.33 (33.33–100)	83.33 (58.33–100)	0.472
Sexual functioning	0 (0–66.67)	0 (0–33.33)	0.194
Sexual enjoyment	50.00 (33–67)	33.34 (0–67)	—
Future perspective	66.67 (0–100)	66.67 (0–100)	0.670
Symptom scale			
Systemic therapy side effects	19.05 (4.76–57.14)	7.14 (0–47.62)	0.007
Breast symptoms	20.84 (0–66.67)	16.67 (0–50)	0.575
Arm symptoms	11.11 (0–77.78)	27.78 (0–88.89)	0.047
Upset by hair loss	66.67 (0–100)	16.67 (0–33.33)	—

Table 5. Quality of Life between 2 Groups before Surgery

Scales	Median (Min–Max)		P
	Keystone	Rotational	
QLQ-C30			
Functional scale			
Global health	62.50 (41.67–83.33)	54.17 (41.67–83.33)	0.535
Physical functioning	90.00 (53.33–100)	90.00 (40–100)	0.930
Role functioning	100 (33.33–100)	100 (50–100)	0.871
Emotional functioning	91.67 (41.67–100)	87.50 (41.67–100)	0.722
Cognitive functioning	83.33 (83.33–100)	100 (50–100)	0.087
Social functioning	100 (33.33–100)	100 (66.67–100)	0.836
Symptom scale			
Fatigue	27.78 (0–55.56)	22.22 (0–77.78)	0.835
Nausea and vomiting	8.34 (0–100)	0 (0–100)	0.405
Pain	33.33 (0–100)	16.67 (0–100)	0.718
Dyspnea	0 (0–33.33)	0 (0–33.33)	1
Insomnia	16.67 (0–100)	0 (0–100)	0.392
Appetite loss	33.33 (0–100)	0 (0–100)	0.247
Constipation	0 (0–100)	0 (0–100)	0.917
Diarrhea	0 (0–66.67)	0 (0–33.33)	0.952
Financial difficulties	33.33 (0–100)	33.33 (0–100)	0.718
QLQ-BR23			
Functional scale			
Body image	91.67 (41.67–100)	83.33 (33.33–100)	0.766
Sexual functioning	8.34 (0–66.67)	0 (0–66.67)	0.603
Sexual enjoyment	33.33 (33.33–66.67)	50.00 (33–67)	0.683
Future perspective	100 (33.33–100)	66.67 (0–100)	0.081
Symptom scale			
Systemic therapy side effects	30.95 (4.76–47.62)	19.05 (4.76–57.14)	0.310
Breast symptoms	25 (0–91.67)	20.84 (0–66.67)	0.381
Arm symptoms	11.11 (0–77.78)	11.11 (0–77.78)	0.593
Upset by hair loss	0 (0–100)	66.67 (0–100)	0.208

When compared between 2 groups, the keystone group had better future perspective [100 (0–100)] compared with the rotational group [66, 67 (0–100)]. A previous study assessing future perspective in early stage breast cancer patients reported mean future perspective of

55–57 for patients with mastectomy and mastectomy with reconstruction.¹⁶ Another study found future perspective at 6 months post-mastectomy was 54.76 ± 27.28.¹⁵ It can be seen that the perspective of future health in patients using keystone flap is better than rotational flap in this study

Table 6. Quality of Life between 2 Groups after Surgery

Scales	Median (Min–Max)		P
	Keystone	Rotational	
QLQ-C30			
Functional scale			
Global health	83.33 (41.67–91.67)	83.33 (58.33–91.67)	0.630
Physical functioning	73.33 (26.67–100)	73.33 (13.33–100)	0.954
Role functioning	66.67 (0–100)	66.67 (0–100)	0.929
Emotional functioning	91.67 (33.33–100)	91.67 (41.67–100)	0.367
Cognitive functioning	100 (66.67–100)	100 (50–100)	0.424
Social functioning	100 (83.33–100)	100 (66.67–100)	0.781
Symptom scale			
Fatigue	22.22 (0–55.56)	27.76 (0–88.89)	0.747
Nausea and vomiting	0 (0–33.33)	0 (0–16.67)	0.514
Pain	33.33 (16.67–100)	16.67 (0–100)	0.195
Dyspnea	0 (0–33.33)	0 (0–66.67)	0.191
Insomnia	0 (0–100)	0 (0–100)	0.665
Appetite loss	0 (0–66.67)	0 (0–66.67)	1
Constipation	0 (0–66.67)	0 (0–100)	0.087
Diarrhea	0 (0–0)	0 (0–0)	1
Financial difficulties	16.66 (0–100)	33.33 (0–100)	0.602
QLQ-BR23			
Functional scale			
Body image	87.5 (0–100)	83.33 (58.33–100)	0.743
Sexual functioning	8.34 (0–50)	0 (0–33.33)	0.093
Sexual enjoyment	50 (33.33–66.67)	33.34 (0–67)	0.683
Future perspective	100 (0–100)	66.67 (0–100)	0.020
Symptom scale			
Systemic therapy side effects	14.29 (0–42.86)	7.14 (0–47.62)	0.189
Breast symptoms	12.5 (8.33–25)	16.67 (0–50)	0.355
Arm symptoms	38.89 (11.11–88.89)	27.78 (0–88.89)	0.639
Upset by hair loss	0 (0–0)	16.67 (0–33.33)	0.114

and previous studies. This may be related to postoperative wound healing.

Palliative mastectomy was originally intended to improve QoL and holistically treat patients as individuals. In late stage breast cancer, mastectomy is performed for palliative treatment even in elderly patients.¹⁷ This study showed a better QoL in global health after mastectomy. Breast symptoms and future perspectives of patients with the keystone flap were also better than with the rotational flap.

Various studies have investigated factors affecting QoL of cancer patients undergoing mastectomy. Social and demographic factors such as age, education, marital status, and employment can affect QoL.^{14,18} Patients below 50 years of age have a better QoL 1 year postoperatively compared with patients aged 60–69 years.¹⁴

Age affects QoL of future perspectives. Patients aged 30–45 years have lower scores than those aged 45–70 years.¹⁸ Consistent with the study from Janz, future perspectives in younger patients have lower values than in those above 70 years old. This might be due to the tendency of mismatch between expectations and current health conditions in younger women, leading to greater impact on QoL.¹⁶ Patients with higher education also rate their QoL better.^{16,18,19} Housewives have also shown a better QoL.¹⁴

Between the keystone and rotational flaps, significant differences are only seen in future perspectives. However, results of patient interviews found that keystone generally provides a better QoL. This is consistent with Behan's theory, which explains the keystone flap response, which is pain-free postoperatively, rapid, and reliable wound healing.²⁰ In addition, some patients also experienced hand

complaints such as swelling in reconstruction with rotational methods.

LIMITATION OF STUDY

The limitation of this study is the small sample size due to low number of patients with no prior chemotherapy or surgery who visited our hospital. Further studies with a much greater sample size are needed to acquire a better perspective on QoL comparison. Possible biases included selection bias due to the consecutive sampling method, and observer bias in delivering explanation about the QOL questionnaire.

CONCLUSIONS

The QoL of late stage breast cancer patients can be affected by malignant wound symptoms. Reconstructive surgery after mastectomy is beneficial for late stage breast cancer patients. Yet, the best local flap for breast reconstruction is still not known. In this study, the keystone flap is superior to the rotational flap in improving global health and breast symptoms. Further study with a larger sample is needed to confirm the superiority.

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