SAFETY AND BENEFITS OF TISSUE EXPANDER/IMPLANT VERSUS LATISSIMUS DORSI WITH/WITHOUT IMPLANT IN POSTMASTECTOMY BREAST RECONSTRUCTION FOR BREAST CANCER PATIENTS: ASYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

Aims*: The study reviewed relevant publications of reconstruction procedure for Asian breast cancer patients with small breasts, and compared postoperative safety and effect outcomes between tissue expander/implant and latissimus dorsi (LD) flaps with/without implant reconstruction.*

Methods: *Public databases were systematically searched to compare tissue expander/implant against LD flaps with/without implant reconstruction. Three reviewers independently screened all reports and selected the relevant articles using specific inclusion criteria. Data were extracted from the relevant articles using a standardized abstraction form.*

Results: *Twelve studies were identified. Significant differences were found between the two approaches. Recipients of LD flaps with/without implant reconstruction had lower risks of surgical-site infections (OR, 0.60; 95% CI, 0.38 to 0.95), lower capsular contracture rates (OR, 0.69; 95% CI, 0.48 to 0.98), were less likely to suffer from reconstructive failure(OR, 0.38; 95% CI, 0.14 to 1.04), and were less likely to have reconstructive reoperation (OR, 0.30; 95% CI, 0.12 to 0.73).Recipients of LD flaps with/without implant reconstruction tended to be esthetically more satisfied than women receiving tissue expander/implant(OR, 2.96; 95% CI, 1.01 to 8.71).For patient satisfaction, no significant difference in the pooled estimates was observed (OR, 0.66; 95% CI, 0.22 to 1.95). Studies were of low to moderate quality according to the Newcastle-Ottawa scale.*

Conclusions: *Thmeta-analysis suggests that LD myocutaneous flap is a good compromise between complication risk and good cosmetic. It is a reliable technique that can be considered as the primary choice for breast reconstruction for Asian women with small- to medium-sized breasts.*

Keywords: *Tissue expander/implant, latissimus dorsi with/without implant, mastectomy, breast reconstruction, meta-analysis.*

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Introduction

The incidence of breast cancer has gradually increased in the world, and body disturbances after a mastectomy may result in psychological damage to patients[(1)]. Breast reconstruction can improve psychological wellbeing and quality of life[(1, 2)], and can be performed using breast implants, autologous tissue, or a combination of the two. However, breasts of Asian women differ from those of Western women in many aspects, as Asian women are usually smaller and have lower body mass index (BMI)[(3)]. These characteristics make Asian women suitable for two major surgical procedures: I) tissue-expander/implant and II) latissimus dorsi(LD) flaps with/without implant. Either approach is associated with different complications and benefits.

Prior studies of breast reconstruction methods have produced somewhat conflicting results in terms of outcomes. Some studies have shown higher satisfaction rates for LD flaps with/without implant re-

construction compared with tissue-expander/implant reconstruction[4, 5]. Other studies have shown that the type of breast reconstruction might not influence satisfaction in breast cancer patients. It is challenging to find a suitable surgery for patients with small breasts.

In an attempt to resolve some of these conflicting satisfaction data, a well-conducted systematic review with meta-analysis using multiple studies could be helpful to obtain a clearer overview.

Few studies have systematically investigated and compared the relative risks and benefits of each operation. The aim of the present study is to review relevant publications, and to compare postoperative safety outcomes (i.e., postoperative complications) and postoperative effect outcomes (i.e., postoperative cosmetic outcomes) between tissue expander/implant reconstruction and LD flaps with/without implant reconstruction for breast cancer patients following mastectomy. Our outcomes research is essential to provide patients with concrete and reliable information to assist in their decision making.

LD flaps with/without implant reconstruction is defined here as either of the following

Latissimus dorsi (LD) flaps only, or latissimus dorsi(LD) flaps with implant.

Tissue-expander/implant reconstruction is defined here as any of the following

Tissue-expander (TE) only, implant (I) only, or tissue-expander with implant (TE+I).

Patients and methods

This systematic review and meta-analysis is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement and was registered at International Prospective Register of Systematic Reviews (number CRD42014010688).

Search strategy

The following databases were systematically searched in Jan 1, 2019, without language and publication date restrictions: Embase, PubMed, Medline and Cochrane. Search keywords combined with Boolean logical operators are listed in Table 1. We considered all potentially eligible studies for review, irrespective of the primary outcome or language. We also did a manual search, using the abstract of key articles published in English.

1. (Breast Implants[MeSH Terms]) OR Breast Implantation[MeSH Terms])
2. ((((((((((tissue expansion) OR expander*) OR tissue* adj expander*) OR tissue expansion device) OR breast prosthesis) OR breast augmentation) OR prosthe*) OR Internal Breast Prosthe*) OR Implants, Breast) OR Breast Implant)
3. 1 or 2
4. ((((((((((Latissimus Dorsi[Title/Abstract]) OR Back Muscle, Superficial[Title/Abstract]) OR Back Muscles, Superficial[Title/Abstract]) OR Muscle, Superficial Back[Title/Abstract]) OR Muscles, Superficial Back[Title/Abstract]) OR Superficial Back Muscle[Title/Abstract]) OR Levator Scapulae[Title/Abstract]) OR Scapulae, Levator[Title/Abstract]) OR Trapezius[Title/Abstract]) OR Trapezius Muscle[Title/Abstract]) OR Muscle, Trapezius[Title/Abstract]) OR Muscles, Trapezius[Title/Abstract]) OR Trapezius Muscles[Title/Abstract]) OR Rhomboid Minor[Title/Abstract]) OR Rhomboid Minors[Title/Abstract]) OR Dorsi, Latissimus[Title/Abstract]) OR Dorsus, Latissimus[Title/Abstract]) OR Latissimus Dorsus[Title/Abstract]) OR Rhomboid Major[Title/Abstract]) OR Rhomboid Majors[Title/Abstract])
5. Breast neoplasm[MeSH Terms]
6. ((((Mammaplasties) OR Mammoplast*) OR Breast Reconstruct*) OR Reconstruction Breast) OR Reconstructions Breast)
7. 5 or 6
8. Breast neoplasm[MeSH Terms]
9. ((Breast cancers) OR mammary carcinoma) OR mammary neoplasm
10. 8 or 9
11. 3 or 4
12. 11 and 7 and 10

Table 1: Search strategy for PUBMED.

Study selection

All studies, whether randomized or nonrandomized, were considered potentially eligible if they aimed to investigate complications and benefits in patients undergoing either tissue expander/implant or LD flaps with/without implant surgery for breast reconstruction.

We regarded these studies as eligible for inclusion:

- Journal literature only;
- Retrospective cohort design;
- Female patients with a diagnosis of breast cancer;
- Studies had to report complication rates or efficacy data (at least one of the following 12 items: implant capsular, hematoma, infection, implant mal position, implant rupture, revision, skin necrosis, reconstruction failure, reoperation, Seroma, patients satisfaction and cosmetic result);
- Articles did not limit the patients' age or follow-up time;
- If there were repeated data, the study with the largest sample size was selected;
- Observational studies must have a sample size greater than 10 per study arm.

Exclusion criteria were as follows:

- Articles with incomplete data or relevant data that could not be extracted;
- Articles in languages other than English;
- Letters, editorials, expert opinions and case reports;

• Patients had rare types of tumors, such as lobes, sarcomas, or lymphomas;

• Articles evaluated chest wall reconstruction for recurrent disease, volume replacement following breast conservation, or prophylactic surgery.

Eligibility was assessed by title and abstract screening, and then full text assessment was performed by two independent researchers (Shuting Qin and Jun Ye). Any disagreements were decided by a third reviewer (YuyongYan). Eventually, 12 studies were included and analyzed in thepresentreview.

of participants, demographics, timing and method of reconstruction, addition of radiotherapy, duration of follow-up, quality of the study and clinical outcomes. The primary outcome was perfusion-related complications, including: implant capsular, hematoma, infection, implant mal position, implant rupture, reconstruction failure, and number of reoperations.

The secondary outcome was postoperative benefits: patient satisfaction and cosmetic result. Any disagreement was resolved through consultation with a third reviewer Yuyong Yan.

Reference	Intervention Studied	Sample Size	Mean Age (Year)	Timing of Reconstruction	Radiotherapy (%)	Smoking (n)	Mean BMI (SD)	Outcomes Reported								
								Capsular	Hematoma	Infection	Malposition	Rupture	Failure	Reoperation	Satisfaction	Cosmetic result
Scott L. Spear 2008	TE/I LD	48 13	NR	Immediate	0	3 2	21.98 25.17					×	×			×
Vincent Pinsolle 2006	TE+I I LD+I LD	27 38 162 39	48	Immediate	Pre 42 Post 14	45	>25 (45) ≤25 (221)				×	×		×	×	×
S.Modena, C 1995	I TE LD LD+TE	4 58 24 2	45.4	Immediate	NR	24	NR		×			×	×	×	×	
BRANDICE DURKAN 2012	I+TE LD	20 9	41.5 49	Immediate	0 2	5	24 25		×	×	×		×	×	×	×
KRISTINA STRA˚LMAN 2008	I LD LD+I	82 26 4	48.1±8.6	Immediate	24	NR	NR		×	×			×	×	×	×
Chen Jia-jian 2015	I LD	86 418	37.1 39.1	Immediate (670) delayed (28)	NR	NR	20.6 21.7	×	×		×		×		×	×
AndriThorarinsson 2015	I I+TE LD	62 303 113	57.4 ±11.6 55.7 ± 9.1 55.3 ± 9.0	delayed	19 49 101	13 60 24	25.1 ±4.1 24.8 ±3.6 25.1 ±3.8						×	×	×	×
Edwin G 2016	LD I+TE	73 1615	50.1	Immediate(2075) delayed(159)	41 86	24 492	26.6							×	×	×
H. c. benditte-Klepetko 2014	I LD LD+I	17 64 5	51.6	Immediate/ delayed	NR	NR	NR				×	×		×		×
R. E. Mansel 1986	I LD	12 38	NR	Immediate	NR	NR	NR			×		×	×	×	×	×
Grant W. Carlson, MD 2001	TE LD	20 18	47.9	Immediate	7	13	NR			×		×	×	×	×	
D.D. Atherton 2010	I LD+I	73 98	48	Immediate	NR	NR	NR			×	×	×	×	×	×	×

Table 2: Specifics of included studies.

Note: BMI, body mass index; PMRT, postmastectomy radiation therapy; BR, breast reconstruction; NR, not reported; TE/I, tissue expander/implant; Pre, receipt of radiotherapy before reconstruction; Post, receipt of radiotherapy after reconstruction.

Data extraction and management

The following data were extracted by Shuting Qin and Jun Ye from each study according to a prespecified protocol: study reference details (e.g., first author, year of publication), study design, number

Critical appraisal

Studies were appraised according to their design. The quality of nonrandomized studies was assessed using the Newcastle-Ottawa scale. This scale evaluates nonrandomized studies against three cri-

teria: selection of study group, comparability, and outcome ascertainment[6]. Follow-up was judged as adequate if the study stated that less than 10% of patients lost follow-up[7]. Comparability (i.e., control of confounding factors) was assessed for all the safety outcomes of interest. Studies achieving a score of 6 or higher, of a maximum of 9, were considered to be of high quality. Quality assessments were carried out independently by two reviewers (Shuting Qin and Jun Ye), and disagreements were resolved by a third investigator (YuyongYan).

Statistical analysis

When practical and feasible, postoperative complications were formally evaluated by meta-analytic techniques. Meta-analysis was performed with adherence to the guidelines of the Meta-analysis of Observational Studies in Epidemiology[8] and the recommendations from the Cochrane Collaboration. The unit of analysis was each individually reconstructed breast. For each study, the relative risk of the simple proportions of events was estimated along with its variance and 95% confidence interval. Heterogeneity in the relative risks for the same outcome across studies was assessed using I2statistics. If heterogeneity was low (I2 <30%), a fixed effect model was applied; if the value of I2 exceeded 30%, a random effect model was used[9].

The overall pooled effect was calculated using either random or fixed effect meta-analysis with Mantel-Haenszel weighting on Review Manager 5.3 (The Cochrane Collaboration, Copenhagen, Denmark). The findings were presented as forest plots. Assessment of potential publication bias was conducted by generating funnel plots.

Results

Study search

The bibliographic search retrieved 3,514 unique abstracts, of which 1,768 were excluded in title/abstract screening. Of the remaining 1,438 publications, 12 observational studies met the inclusion criteria and were included following full-text review (Figure 1). The κ score on the level of agreement between the two reviewers was 0.55 for title/abstract screening and 0.72 for full-text screening, indicating moderate and substantial agreement, respectively.

Description of the included studies

The 12 identified studies included 5,067 reconstructed breasts and involved 2,465 breasts reconstructed by tissue expander/implant and 1,106 breasts reconstructed by LD flaps with/without implant. All studies compared tissue expander/implant against LD flaps with/without implant, and were cohort trials. Most lyof the trials were conducted in America (n = 5)[1, 4, 7,1 0, 11], with one in France[2], one in Italy[3], one in Denmark[5], one in China[12], one in Sweden[6], one in Austria[8], and one in England[9]. The mean follow-up period ranged from 7 months[2] to 42.7 months[10] (Table 1).

The majority of studies had small sample sizes, with only six studies involving more than 100 breasts[2, 5, 6, 7, 8,12] (Table 2). The selection criteria for participants were never random; instead, all studies relied on convenience sampling, with a small subset using consecutive sampling strategy[1].

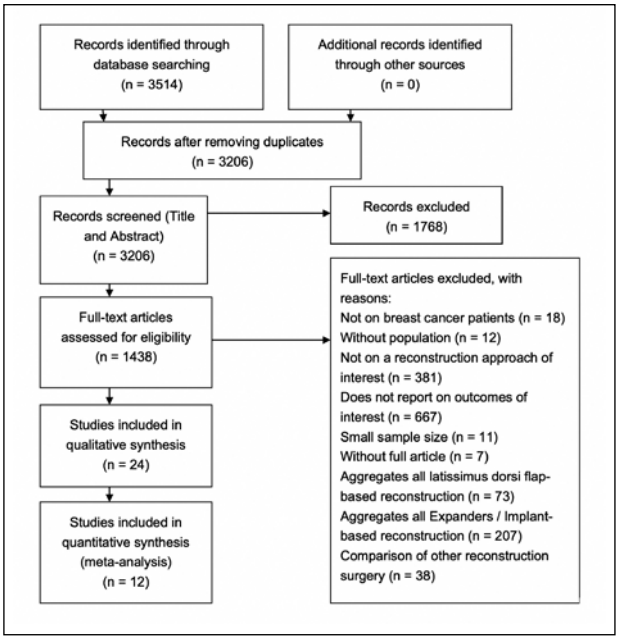

Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram of literature search for articles on Safety and benefits outcomes of different approaches to breast reconstruction.

Critical appraisal and potential bias

According to the Newcastle-Ottawa scale,the mean score was 7.58 of 12 (Table 3). None of the identified studies explicitly addressed follow-up. The subsequent meta-analysis took the unadjusted estimates to pool the results.

In terms of reporting quality, the Strengthening the Reporting of Observational Studies in Epidemiology guidelines highlighted the fact that the sources of funding were rarely reported[8, 9, 12] (Table 3). None of the studies justified sample size or explained how missing data were handled. Only one study explicitly addressed loss to follow-up[11].

References	Countries	Type of Study	Mode of Sampling	Intervention Compared	Outcome Reporting		Newcastle-Ottawa Quality Assessment Score
					Data Accrual Mean	Follow-Up (months)	
Scott L. Spear 2008	American	Cohort	Retro	TE/I LD flap TRAM	Convenience Sample	36	8
Vincent Pinsolle 2006	France	Cohort	Retro	TE I LD+I LD	Convenience Sample	7 (2-14)	8
S. Modena, C 1995	Italy	Cohort	Retro	TE LD LD+TE	Convenience Sample	21	8
Brandice Durkan 2012	American	Cohort	Retro	I+TE LD I LD LD+I TRAM	Convenience Sample	I+TE(13) LD(11)	7
Kristina Stra¨Lman 2008	Denmark	Cohort	Retro	I LD TRAM Free-flap	Convenience Sample	34±30	8
Chen Jia-jian 2015	China	Cohort	Retro	I I+TE LD DIEP	Convenience Sample	37.1	7
Andri Thorarinsson 2015	Sweden	Cohort	Retro	LTDF LD	Convenience Sample	I(30.5 ± 16.7) TE+I(28.8± 18.8) LD (32.2 ± 19.1)	7
Edwin G 2016	American	Cohort	Retro	I+TE PTRAM Free TRAM DIEP	Convenience Sample	NA	7
H. c. ben-ditte-Klepetko 2014	Austria	Cohort	Retro	I LD LD+I TRAM DIEP	Convenience Sample	38.4	7
R. E. Mansel 1986	England	Cohort	Retro	I LD Rectus abdominis	Convenience Sample	>12	8
Grant W. Carlson, MD 2001	American	Cohort	Retro	TE LD TRAM	Convenience Sample	42.7	8
D.D. Atherton 2010	American	Cohort	Retro	I LD+I TRAM DIEP	Convenience Sample	36	7

Table 3: Summary of Included Studies.
Note: TE/I,tissue expander/implant; LD, Latissimus Dorsi flap; TRAM, transverse rectus abdominismyocutaneousflap;DIEP, deep inferior epigastric perforator flap.

Complications common among the two different approaches to reconstruction

Certain complications were reported in both approaches, and these were pooled. Recipients of LD flaps with/without implant reconstruction had lower risks of surgical site infections (event rates: LD flaps with/without implant, 29 of 566; tissue expander/implant, 232 of 2,262; OR, 0.60; 95% CI, 0.38 to 0.95) (Figure 2).

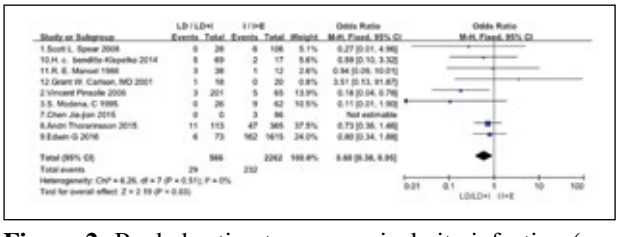

Figure 2: Pooled estimates on surgical-site infection (notincluding donor-siteinfection).

The pooled estimates suggested a trend towards lower capsular contracture rates in recipients of LD flaps with/without implant than those of tissue expander/implant reconstruction (event rates: LD flaps with/without implant, 57 of 695; tissue expander/implant, 145 of 2,437;OR, 0.69; 95% CI, 0.48 to 0.98) (Figure 3).

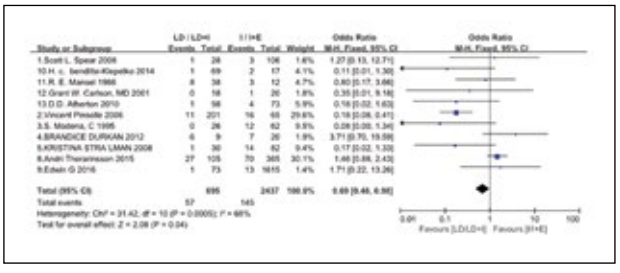

Figure 3: Pooled estimates on the development of capsular contracture.

Patients undergoing LD flaps with/without implant reconstruction were less likely to suffer from reconstructive failure(event rates: LD flaps with/without implant, 7 of 274; tissue expander/implant, 100 of 1,680; OR, 0.38; 95% CI, 0.14 to 1.04) (Figure 4).

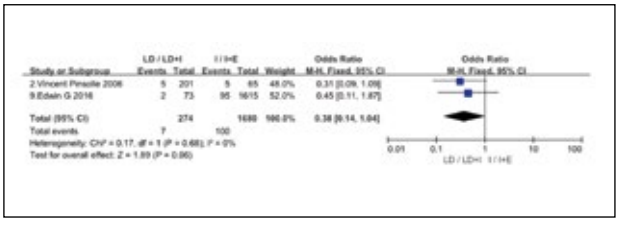

Figure 4: Pooled estimates on reconstructive failure.

In contrast, reoperation was 0.30 times more likely to occur following tissue expander/implant reconstruction (event rates: LD flaps with/without implant, 8 of 446; tissue expander/implant, 21 of 192; OR, 0.30; 95% CI, 0.12 to 0.73)(Figure 5).

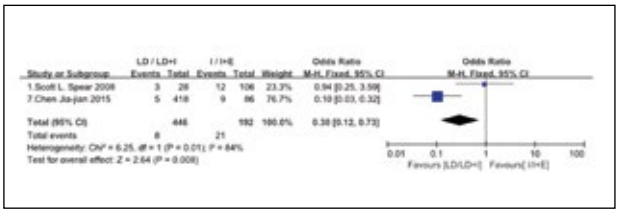

Figure 5: Pooled estimates on reoperation.

For the remaining safety outcomes (i.e., hematoma, implant malposition or breakage, implant rupture), no significant difference in the pooled estimates was observed between approaches to reconstruction (Figures. 6-9).

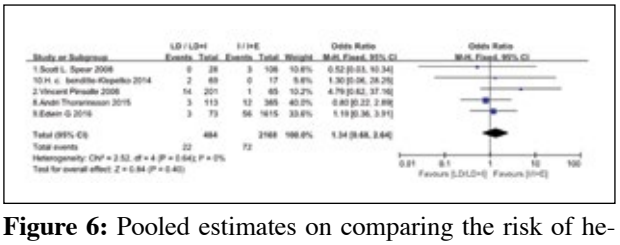

Figure 6: Pooled estimates on comparing the risk of hematoma between LD/LD+I group and I/I+E group.

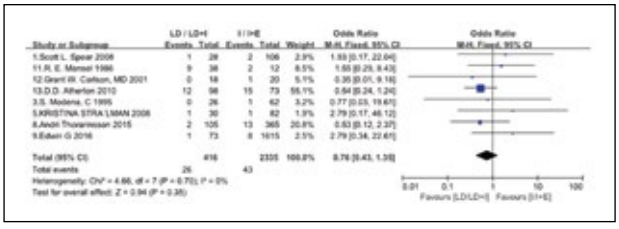

Figure 7: Forest plot comparing the risk of implant malposition between LD/LD+I group and I/I+E group.

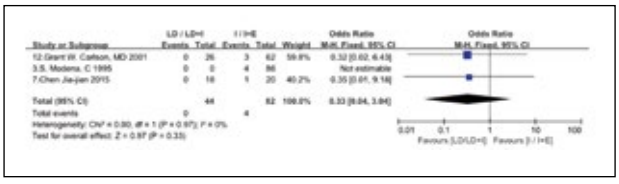

Figure 8: Forest plot comparing the risk of breakage between LD/LD+I group and I/I+E group.

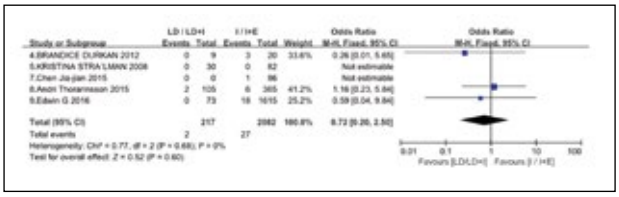

Figure 9: Forest plot comparing the risk of implant rupture between LD/LD+I group and I/I+E group.

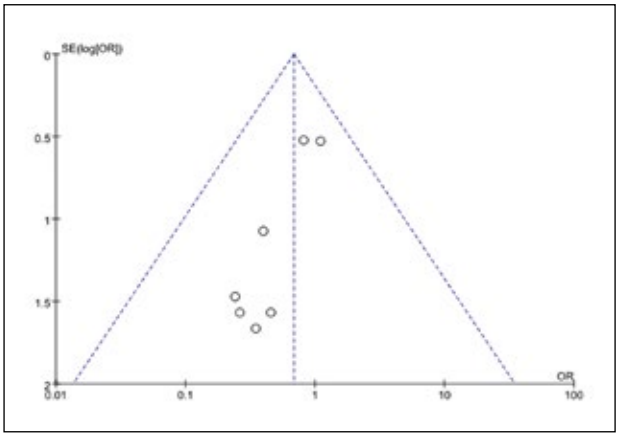

Figure 10: Funnel plot of the analysis for the risk of skin necrosis. (Above) Primary outcome analysis: skin necrosis. Potential publication bias was assessed by generating funnel plots. Figure 10 displays a funnel plot of the analysis for skin necrosis. A relatively symmetrical plot was observed, suggesting low possibility of publication bias. All other analysis also showed similar symmetric-shaped funnel plots (graph not shown).

Psychosocial and functional outcomes of the two different approaches to reconstruction

Psychosocial and functional outcomes included physical/functional well-being expression).In terms of physical or mental well-being, 5 unique studies reported this outcome[1, 3, 8, 10, 12].

The majority of the studies used validated instruments,such as: de-identified photographs)[1, 3, 10], medical records[1, 3, 12] and questionnaire[8, 10, 12]. For professional patient photographs with frontal and bilateral oblique views for each patient, 2-4 blinded plastic surgery residents reviewed the photographs and scored results[1, 3, 10]. Questionnairewas developed based on questionnaires previously used to assess surgical procedures of the breast, including European organization for Research and Treatment of Cancer Breast Cancer-Specific Quality of Life (Eo RTC QLQBR-23), short-form 36-item health survey (SF-36), and Functional Assessment of Cancer Therapy-Breast (FACT-B)[8, 12].

Recipients of LD flaps with/without implant reconstruction tended to be aesthetically more satisfied than women receiving tissue expander/implant(event rates: LD flaps with/without implant, 32 of 41; tissue expander/implant, 48 of 71;OR, 2.96; 95% CI, 1.01 to 8.71) (Figure 11). For patient satisfaction outcome, no significant difference in the pooled estimates was observed between the two approaches to reconstruction(event rates: LD flaps with/without implant, 130 of 183; tissue expander/implant, 60 of 66;OR, 0.66; 95% CI, 0.22 to 1.95) (Figure 12).

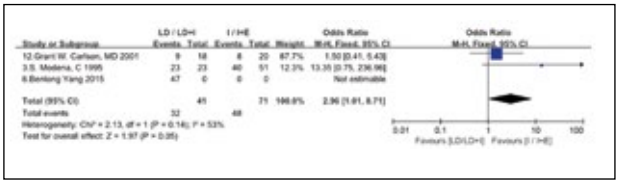

Figure 11: Pooled estimates oncosmetic.

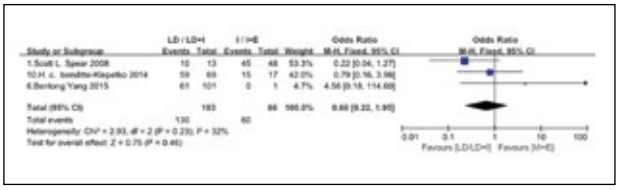

Figure 12: Pooled estimates on patients satisfaction.

Discussion

It is challenging to find a suitable reconstruction procedure for Asian breast cancer patients with small breasts[1, 12]. In order to find a suitable procedure for Asian patients, the present article evaluated general complications and aesthetic satisfaction with reconstructive surgery of two breasts in 12 systematic previous studies[6]. Postoperative complications are common for breast reconstructive surgeries, and they affect the patients' emotional well-being and level of satisfaction and potentially impact on scheduled adjuvant therapy[7, 13], including infection, being one of the major concerns after the surgery. Our data supported the prior results. The present meta-analy-

sis demonstrated that the risk of infection was significantly enhanced in the implants cohort[12]. Past reviews showed that in comparison to subpectoral implants, latissimus dorsi myocutaneous flaps have a higher blood supply and a better coverage around the implant, allowing better defense against infection[2, 8]. Capsular contracture is an important factor because it has been identified by several authors as a major cause of poor cosmetic result[14, 15].

Past reviews show that breast reconstructions by implant alone have a rate of capsular contracture more than three-fold higher than reconstruction with implant in conjunction with a flap[16], while a significantly elevated risk was observed in the implants cohort of the present study. We think that a myocutaneous flap around an implant decreases the risk of capsular contracture more effectively than an implant in the subpectoral position as usually recommended[17]. Compared to subpectoral implant, the thickness of the myocutaneous flap allows implanting a smaller prosthesis deeper from the skin. In our opinion, the mechanism explains this difference[2]. Another factor influencing the complication rate in the implant-based reconstruction groups was that a considerable number of patients in these groups had received radiotherapy. The risk of capsular contracture has been reported to be high in irradiated implant-based reconstruction, which can give poor cosmetic results and pain, and further increase the risk of infection that can result in implant extraction[18, 19].

Another distinct finding of this study is that the reconstruction of LD flap with or without an implant reduces the risks of unplanned return to OR and reconstructive failure. Past reviews did not find a significant difference in unplanned return to OR and reconstructive failure between those using a flap and those using an implant alone[2]. Based on the findings of the current meta-analysis, it can be assumed that the application of flap would reduce the risk of serious complications including reconstruction failure and overall operation-related morbidity. Unplanned return to OR and reconstructive failure are rare events, and perhaps a larger population is necessary to find a difference[20].

The results of the analysis regarding the risk of hematoma, implant mal position or breakage, implant rupture are noteworthy. As they are dreadful complications in implant-based breast reconstruction causing serious morbidity, our data did not find a significant difference in them between those using LD flap and those using an implant alone. As skin sparing mastectomies were used in LD flap-based breast reconstruction, mastectomies were usually used in implant-based breast reconstruction[21].Past reviews show that skin sparing mastectomies have a higher risk of hematoma than conventional mastectomies. Difficult exposition to obtain perfect homeostasis may account for this risk. When a skin sparing mastectomy is performed, the bleeding could be controlled twice by each surgeon to avoid hematomas. Otherwise, hematomas, frequently favorable infections, can be prevented by using closed system aspiration drains[22].

In contrast to previous studies showing approximately three times increased risk in the implant-based group, the risks of implant mal position or breakage were not significantly affected by whether a flap was used in the present analysis. This result may be surprising, given that the risk of infection, capsular contracture, unplanned return to OR and reconstructive failure were significantly elevated in the implant cohort. It can be assumed that although the use of flap reduces the risk of other complications including infection, the complications may not be that serious and can be controlled without causing implant removal. Otherwise, with the accumulation of experience and knowledge regarding the use of implant-based reconstruction, technique of complication control could be advanced, contributing to the lowering of the risk of complications.

The evaluation of the aesthetic results of breast reconstruction has received little attention[23, 24]. An ordinal scale, consisting of four categories (poor, fair, good, and excellent) is usually used to tabulate aesthetic results. Some studies have reported on cosmetic results[3, 11, 12] or patient satisfaction[1, 9, 12] with breast reconstruction using subjective criteria that are difficult to reproduce and compare.

Breast reconstruction with implant alone involves complications such as capsular contracture or infection. These complications provide poor cosmetic result. Most studies have consistently high satisfaction and aesthetic results for LD flap-based reconstructions[25, 26, 27, 28]. These two facts seem to be linked, and a latissimus dorsi myocutaneous flap, no matter if it is associated with an implant, should be preferred to a subpectoral implant alone owing to the decreased risk of capsular contracture. Otherwise, the results of immediate breast reconstruction using flaps are steadier than the results obtained with reconstruction by implant alone[14, 26]. In contrast, other studies suggest that patients are equally satisfied with implant-based reconstruction compared with LD flap reconstruction[8, 10, 12, 28].

The present meta-analysis demonstrated that the cosmetic results were significantly enhanced in LD flap-based cohort. However, given that this positive result was based on only three studies with low level of evidence, further well controlled studies are required to obtain more solid conclusions.

The results of the present meta-analysis quantified much of what we have suspected all along. First, in studies that directly compare the two procedures, implant-based breast reconstruction has higher risk of infection, capsular contracture, risks of unplanned return to OR and reconstructive failure than LD flap-based reconstruction. There was no significant difference in hematoma, implant mal position or breakage, implant rupture between the two procedures. Second, the present meta-analysis demonstrated that the cosmetic results were significantly enhanced in LD flap cohort. The present study only examined outcome with respect to complications and satisfactions after breast reconstruction.

In order to obtain a complete comparison between different breast reconstruction methods, perioperative data, patient-related factors, and assessments of health-related quality-of-life are required. Such investigations would presumably alter the overall assessment of these methods[18].

Generalizability of studies

There are some limitations in the present study:

• When collecting complication data,our study relied on a retrospective cohort, not a randomized controlled trial (RCT) design. At the beginning of the study, we had tried to conduct a meta-analysis using only randomized controlled studies. However, as there was only one study found, we decided to expand our inclusion criteria to capture a greater number of relevant studies, though this could lower the strength of the meta-analysis.

• Results from studies with a smaller sample size (<100 participants) may be less generalizable.

• In baseline, responders were in all characteristics and complication rates comparable to non-responders. It is still possible that highly satisfied or highly dissatisfied patients were more willing to respond to the questionnaire.

• BMI, cancer staging, preoperative chemotherapy and postoperative radiotherapy can also affect the complication rates. However, their impact could not be assessed in this analysis because of insufficiency of extractable data. Therefore, randomized clinical trials with large sample sizes, standard follow-up plans and volumetric measurement methods are required for further exploration of the efficacy and safety of breast reconstruction.

Conclusions

Despite of the above-mentioned limitations, the present study is one of the few to describe the outcomes of immediate LD flap reconstruction as compared with expander/implant reconstruction after mastectomy. In conclusion, the present study attempted to compare potential benefits and risks between the two reconstructive methods by conducting a meta-analysis with 12 recent publications. This meta-analysis suggests that LD myocutaneous flap, whether in conjunction with an implant or not, is a good compromise between complication risk and good cosmetic. It is a reliable technique that can be considered as the primary choice for breast reconstruction for Asian women with small- to medium-sized breasts. Compared with other options, it involves shorter operation times and fewer complications, is economical, provides enough volume, and is cosmetically good.

The main disadvantages are the need for prolonged drainage and the formation of seromas at the donor site, which can be prevented by several methods. This information would be beneficial for patients who are counseling and making preoperative planning.

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Availability of data and materials:
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions:
SQ contributed to the conception and design of the study. BL, JY, GYe and JX performed the experiments. BL, JY, SL and YY analyzed the data. SQ, BL, JY and GYin interpreted results and prepared the manuscript. The final version of the manuscript has been read and approved by all authors.

Ethical approval and consent to participate:
All procedures performed in the current study were approved by the Ethics Committee of The First Affiliated Hospital of Guangxi Medical University. Written informed consent was obtained from all patients or their families.

Consent for publication:
Written informed consents for publication of any associated data and accompanying images were obtained from all patients or their parents, guardians or next of kin.

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