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Outcome of Quality of Life for Women Undergoing Autologous versus Alloplastic Breast Reconstruction following Mastectomy: A Systematic Review and Meta-Analysis

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Patient-reported Health

Hot Topic Video

Background: This review aimed to meta-analyze the quality of life of alloplastic versus autologous breast reconstruction, when measured with the BREAST-Q.

Methods: An electronic PubMed and EMBASE search was designed to find articles that compared alloplastic versus autologous breast reconstruction using the BREAST-Q. Studies that failed to present BREAST-Q scores and studies that did not compare alloplastic versus autologous breast reconstruction were excluded. Two authors independently extracted data from the included studies. A standardized data collection form was used. Quality was assessed using the Newcastle-Ottawa Scale. The mean difference and 95 percent confidence intervals between breast reconstruction means were estimated for each BREAST-Q subscale. Forest plots and the I^2 statistic were used to assess heterogeneity and funnel plot publication bias. The Z test was used to assess overall effects.

Results: Two hundred eighty abstracts were found; 10 articles were included. Autologous breast reconstruction scored significantly higher in the five subscales than alloplastic breast reconstruction. The Satisfaction with Breasts subscale indicated the greatest difference, with a mean difference of 6.41 (95 percent CI, 3.58 to 9.24; I^2 = 70 percent). The Satisfaction with Results subscale displayed a mean difference of 5.52. The Sexual Well-Being subscale displayed a mean difference of 3.85. The Psychosocial Well-Being subscale displayed a mean difference of 2.64. The overall difference in physical well-being was significant, with high heterogeneity (mean difference, 3.33; 95 percent CI, 0.18 to 6.48; I^2 = 85).

Conclusion: Autologous breast reconstruction had superior outcomes compared with alloplastic breast reconstruction as measured by the BREAST-Q. (*Plast. Reconstr. Surg.* 145: 1109, 2020.)

Breast cancer is recognized as the most frequently diagnosed cancer in female patients worldwide.[1] Surgical intervention including mastectomy is considered an integral part of and often is essential to favorable therapeutic

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outcome[2] in many patients. Furthermore, prophylactic mastectomy is an effective treatment option in individuals that have higher risk of developing breast cancer, namely, in women with a *BRCA* gene mutation or strong family history of the disease.[3] Despite its therapeutic benefits, surgical intervention can be both physically and psychologically debilitating, with resultant sexual or body-image tribulation.[4] For such individuals, breast reconstruction may be offered primarily or secondarily,[5] using either autologous or alloplastic reconstructions techniques.[6]

Both methods have been shown to improve patients' satisfaction with breast(s) and consequently their quality of life following mastectomy.[7] It would be helpful to know which breast reconstruction technique is associated with greater quality-of-life outcomes. Guyomard et al.[8] conducted a literature review, but the study was more focused on breast reconstruction and was inconclusive as to superiority of any reconstruction technique and reported methodologic deficiencies. Winters et al. drew a similar conclusion after their systematic review, acknowledging that most of the studies reviewed were retrospective, underpowered, and with inherent limitations.[9] However, a new era started after Pusic et al. designed the BREAST-Q, a patient-reported outcome measure.[10] The BREAST-Q has the following subscales: Satisfaction with Breasts, Satisfaction with Results, Psychosocial Well-Being, Sexual Well-being, Physical Well-Being (Chest), Physical Well-Being (Abdomen), Physical Well-Being (General), Satisfaction with Nipples, Satisfaction with Information, Satisfaction with Medical Care, and Satisfaction with Surgeon. Each scale displays a score from 0 (very dissatisfied) to 100 (very satisfied).

The primary outcome in this study was the patient-reported quality of life and satisfaction with reconstructed breast (s), as measured with the BREAST-Q.[10] This is currently the only instrument in reconstructive breast surgery that meets international standards in terms of development and validation.[11] An increasing number of researchers and surgeons incorporate the BREAST-Q in their studies.[12] The BREAST-Q has increased the use of patient-reported outcome measures in breast surgery and has provided numerous important insights in its brief existence.[13] The aim of our review was to evaluate which breast reconstruction technique gives the best improvement in individual quality of life and achieve satisfaction as measured with a patient-reported outcome. To that end, we reviewed and meta-analyzed the literature to assess the patient-reported outcome measures of alloplastic versus autologous postmastectomy breast reconstruction as measured by the BREAST-Q.

PATIENTS AND METHODS

Search Strategy

An electronic literature review was performed to identify publications that evaluated alloplastic breast reconstruction compared to autologous breast reconstruction regarding quality of life and satisfaction with breasts as measured with the BREAST-Q on October 24, 2016. (**See Appendix, Supplemental Digital Content 1**, which shows electronic searches used for this study, ***http://links.lww.com/PRS/E30***.) Two search engines, PubMed and EMBASE, were used. The search was supported by a trained medical librarian. For an overview of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses study flow diagram, see Figure 1. The search was updated on November 23, 2018. This last EMBASE search found a total of 280 abstracts. However, no new article was eligible to be added.

Inclusion and Exclusion Criteria

All studies that compared autologous and alloplastic breast reconstruction and presented BREAST-Q scores as an outcome were included. Autologous breast reconstruction included those patients who underwent a deep inferior epigastric perforator flap, transverse myocutaneous gracilis flap, free or pedicled transverse abdominis musculocutaneous flap, superficial inferior epigastric artery flap, or latissimus dorsi flap. Alloplastic reconstruction included those patients who had been treated using a direct implant or tissue expander followed by implant with or without any regional flaps.[14] Included were studies in which women had undergone mastectomy for therapeutic or prophylactic reasons. Excluded were studies that included only one breast reconstruction method, studies that did not present the BREAST-Q scores, conference abstracts, letters to the editor and non-English articles, studies related to male breast cancer, and studies on women after breast conserving therapy.

Study Selection

The retrieved citations were imported into Excel (Microsoft Corp., Redmond, Wash.). Two medical doctors (Y.E. and I.S.K.T.) independently reviewed all titles and abstracts based on a priori defined criteria. Each title and abstract was

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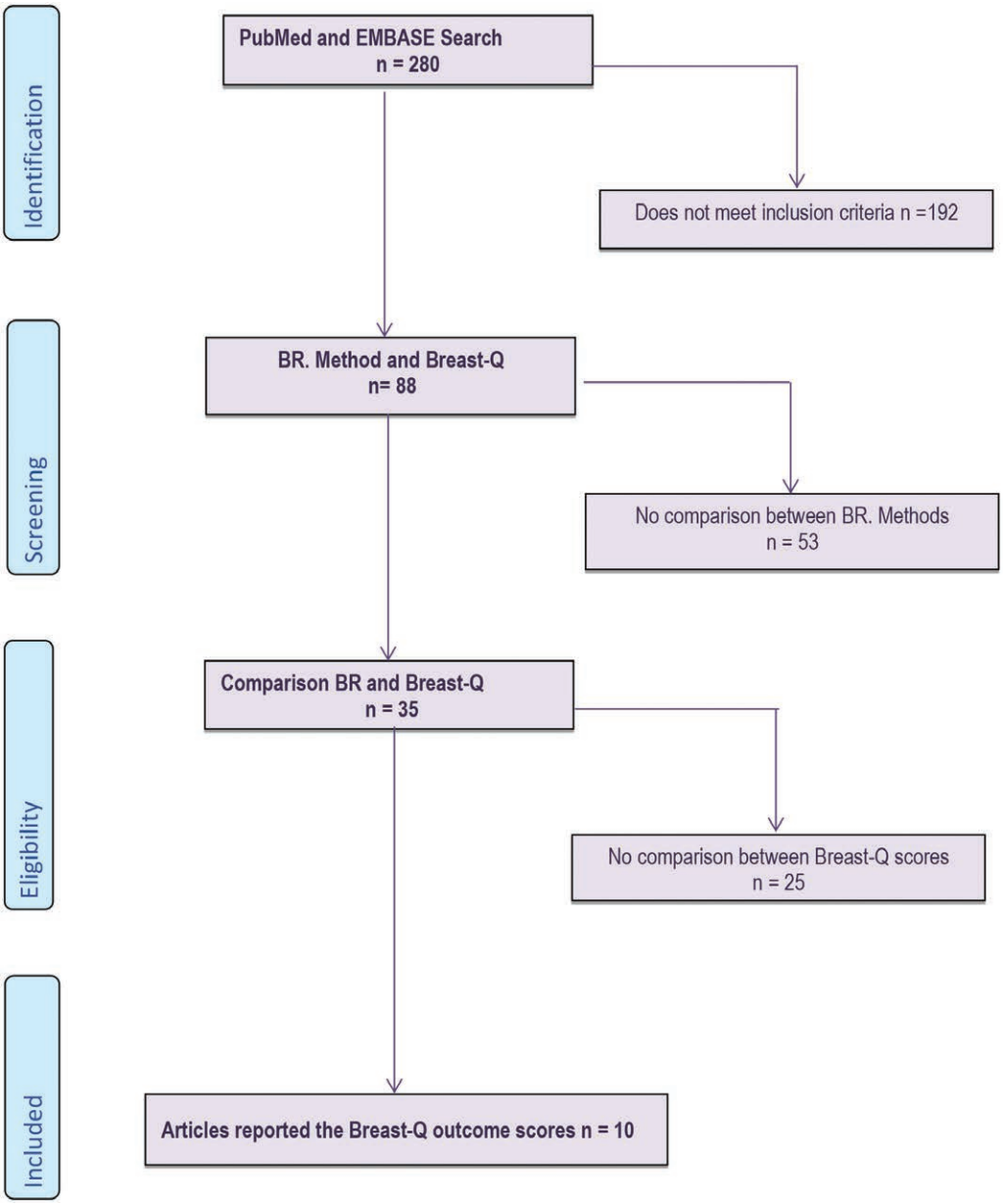

Fig. 1. Flowchart. *BR*, breast reconstruction.

studied, and if it remained inconclusive whether a study could be included or not, the full article of the study was retrieved and studied. In case of any discrepancy, this was discussed with a senior clinician (P.M.N.W.). For a Preferred Reporting Items for Systematic Reviews and Meta-Analyses study flow diagram, see Figure 1.

Data Extraction and Risk-of-Bias Assessment

The same authors (Y.E. and I.S.K.T.) independently extracted data from the included studies for data collection and to evaluate methodologic quality. A standardized data collection form was used to collect and classify all the data and characteristics of the included studies. To evaluate the methodologic quality of the studies, The Newcastle-Ottawa Scale was applied. Again, in case of any discrepancy, this was discussed with a senior clinician (P.M.N.W.). In five studies satisfying our inclusion criteria, but with limited information or missing data, we contacted the authors with additional questions or a request to provide us with the missing or additional data.[15–19] Otherwise, we used the data of three studies[15–17] as presented and discussed possible consequences of missing data. Two studies were excluded because the missing data could not be retrieved.[18,19]

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Data Synthesis

The subscale considered the primary outcome was Satisfaction with Breasts. The other BREAST-Q subscales were considered secondary outcomes. For each study, the mean difference and 95 percent confidence intervals between autologous and alloplastic breast reconstruction were estimated for each scale of the BREAST-Q and described. If there were at least four studies providing data for a given scale, these mean differences were displayed in a forest plot and pooled under the assumption of homogeneity by a random effect model, to allow variation. Statistical heterogeneity was assessed using the I^2 statistic, which was interpreted as follows: 0 to 40 percent, probably not important; 30 to 60 percent, moderate heterogeneity; 50 to 90 percent, substantial heterogeneity; and 75 to 100 percent, substantial heterogeneity.[20] We performed separate analyses on the studies with a minimum follow-up of 12 months for the scales with a high heterogeneity. The definition and distribution of subtype breast reconstruction techniques among both the alloplastic and the autologous groups and the time between breast reconstruction and administration of the BREAST-Q (follow-up) were assessed, as they were assumed to be influencers of clinical heterogeneity. To test the differences between the two techniques, the Z test was used. Statistical significance was considered at $p < 0.05$. Publication bias was assessed using funnel plots for the most frequently used subscale (Physical Well-Being) and the primary outcome (Satisfaction with Breasts). We also included patient characteristics from studies that might be useful to interpret the BREAST-Q scores, assess clinical heterogeneity, and compare the patient populations using descriptive statistics. Meta-analyses were performed using Review Manager (RevMan) Version 5.3 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark).

RESULTS

Study Characteristics

Literature search identified 280 unique articles, of which 10 studies met our inclusion criteria (Fig. 1). In total, 4957 patients were enrolled in these 10 studies, of which in total 3836 patients filled out the BREAST-Q (Table 1).[10,15–17,21–26] All studies except two were retrospective, cross-sectional studies; the remaining two were prospective studies. The time between breast reconstruction and administration of the BREAST-Q varied widely among the articles included in this review (range, 3 to 84 months). The definition of alloplastic and autologous breast reconstruction varied also among the studies: one study defined latissimus dorsi with implant as autologous breast reconstruction[17]; others included latissimus dorsi with implant into the alloplastic group.[16,21] Most studies did not further specify which subtechniques of breast reconstruction were performed among the alloplastic and/or autologous group.[15,16,21,23,26]

The overall mean age of all patients included in this analysis was 51.4 ± 3.8 years (Table 2). Four studies investigated the age of the breast reconstruction groups and found that women undergoing autologous breast reconstruction (range overall mean, 51 to 52.3 years) were slightly older in all four studies compared with the women undergoing alloplastic breast reconstruction (range overall mean, 44 to 50 years). As for body mass index, one study focused specifically on thin patients and therefore the mean body mass index was lower among the patients included in that study (alloplastic, 20.3 kg/m^2; autologous, 21.2 kg/m^2)[17] compared to the patients included in the remaining studies (overall mean range, 23.5 to 25.9 kg/m^2 for the alloplastic group and 26.0 to 30.2 kg/m^2 for the autologous group). Eight studies reported data on smoking, and a large variety in incidence was found among the studies (2.7 to 31.8 percent). The overall complication incidence was high (15.7 to 46.6 percent), and was reported in four studies.[15,16,21,22] Five studies reported complication incidence for autologous versus alloplastic breast reconstruction, which mostly showed a higher overall incidence for the autologous group (overall mean range, 29.2 to 46.6 percent versus 15.8 to 31.1 percent for alloplastic breast reconstruction).[7,10,15,22,25] However, when looking at the percentage of the overall complications that were major or led to reconstructive failure, the percentages were higher among the alloplastic group compared with the autologous group (overall mean range, 60 to 83 percent versus 30 to 60 percent). The studies included reported major complications as complications for which readmission or surgical exploration was necessary.

Quality Assessment

The Newcastle-Ottawa Scale for cross-sectional studies measured an average 8 points[7–9] from a maximum score of 13 points (Table 1).

BREAST-Q

In all studies, data were presented for the Physical Well-Being scale of the BREAST-Q (Table 3). All but two publications[17,24] used the Satisfaction with Breasts, Sexual Well-Being, and Psychosocial Well-Being scales. The Satisfaction with Information

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Table 1. Article Summary

Reference	Study Design	Inclusion Criteria	Exclusion Criteria	Participants, Response Rate %	Mean Follow-Up (Range) (%)*	Autologous BR	Alloplastic BR	Study Quality Scale
Santosa et al., 2016[15]	R	Data from patients enrolled in the Mastectomy Reconstruction Outcomes Consortium Study, from February of 2012 to January of 2014. Any woman who completed implant-based or autologous reconstruction and had at least 2 yr of follow-up from their reconstruction date.	Those who received latissimus dorsi with and without tissue expander/implant reconstructions; women who received a combination of implant and autologous-based techniques. Those who changed their reconstructive technique during enrollment in the study. Those who received immediate reconstruction after mastectomy on one side and delayed reconstruction on the other side. Those who did not complete the study's preoperative surveys. Those who experienced reconstructive failure.	1447 (94.%)	24	472 NFS	1059 NFS	8
Dean et al., 2016[16]	R	The Flinders Breast Reconstruction Service, University Hospital, southern area of South Australia. All patients referred from January 1, 2010, until December of 2014 completed the BREAST-Q (reconstruction module). An ideal data set patient would complete three to four postoperative BREAST-Q questionnaires, with one at 3 mo postoperatively, one between 6 and 9 mo, one at 12 mo after reconstruction, and one after completion of all reconstructive procedures.	—	363 (—)	6	69 NFS	93 NFS	7
Johnson et al., 2016[17]	R	Women diagnosed with ductal carcinoma in situ or invasive breast cancer (American Joint Committee on Cancer stage 0–III) between January 1, 2005, and December 31, 2011, underwent mastectomy at North Shore University Health System. Aged 65 yr or older at the time of mastectomy. Sample of women with similar clinical characteristics who were younger than 65 yr was surveyed for comparison.	—	211 (75.4)	60 (12–84)	41 included combined with implant	83 NFS	8
Weichman et al., 2015[25]	R	All patients undergoing breast reconstruction at a single institution between November of 2007 and May of 2012. Preoperative BMI ≤22 kg/m^2, follow-up of at least 6 mo.	Preoperative BMI >22 kg/m^2. Without documented BMI. Lacked 6 mo follow-up. Had a reconstruction with one-stage direct-to-implant reconstruction, pedicled flaps alone, or a combination of pedicled flaps and implants.	133 (49.2)	3	25 NFS	108 NFS	8

(*Continued*)

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Table 1. *Continued*

Reference	Study Design	Inclusion Criteria	Exclusion Criteria	Participants, Response Rate %	Mean Follow-Up (Range) (%)*	Autologous BR	Alloplastic BR	Study Quality Scale
Pusic et al., 2009[10]	P	Age 18 yr or older, undergoing first-time, immediate or delayed, bilateral or unilateral postmastectomy breast reconstruction for cancer treatment or prophylaxis. Completed baseline survey. 1-yr follow-up since the initial reconstruction. Breast cancer diagnosis. Undergoing immediate breast reconstruction. Completed baseline survey. 1-yr follow-up since the initial reconstruction.	Previous failed reconstruction attempts. Did not complete a baseline (i.e., preoperative) questionnaire. Those who had not completed removal of their TE and exchange for implant at the time of the 1-yr questionnaire or who had their exchange procedure <3 mo before the survey. Patients who had a mixed approach to reconstruction. Prophylactic mastectomy. Delayed reconstruction. Did not complete baseline survey. Less than 1 yr of follow-up. Excluded types of reconstruction: patients in TE/I group did not undergo TE exchange 3 mo before 1-yr survey. Reconstructive failure.	1632 (72.5)	12	386; DIEP; 294; PTRAM, 75; FTRAM, 69; SIE, 55	795; TE, 1052; DI, 87	9
McCarthy et al., 2014[24]	R	Consecutive patients treated between 2003 and 2008 aged 21 yr and older. History of mastectomy alone, immediate postmastectomy two-stage tissue expander/implant reconstruction, or immediate postmastectomy autogenous tissue flap reconstruction. Date of completed mastectomy or reconstruction at least 1 yr but no more than 5 yr prior. Able to read and complete a questionnaire booklet written in the English language.	History of irradiation. Delayed postmastectomy reconstruction. Combined autologous tissue/implant breast reconstruction. Documented local recurrence of breast cancer. History of complex regional pain syndrome.	308 (68.1)	30 (12–60)	74 NFS	141 NFS	8
Eltahir et al., 2015[21]	R	Successful BR at UMCG between 2006 and 2010 included women with a good understanding of the Dutch language and signed informed consent.	Age younger than 18 yr, legally incompetent women. Metastasis or severely ill patient. Reconstruction failure. Women who did not give informed consent.	92 (72)	25 (4–48)	47; DIEP, 41; TMG, 4; TRAM, 1; DIEP plus SIEA, 1	45; IO, 32; LD plus I, 12; SIEA plus I, 1	9
Lagendijk et al., 2018[23]	R	Participants were recruited by means of an online survey available from February 12 to March 13, 2017. The survey was available on the website of the Dutch breast cancer association and the social media page of our institute.	Patients that had not undergone surgery (yet) or that had undergone surgery <6 mo. Questionnaires contained no data.	496 (79)	60 (36–84)	38 NFS	72 NFS	7

(*Continued*)

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Table 1. *Continued*

Reference	Study Design	Inclusion Criteria	Exclusion Criteria	Participants, Response Rate %	Mean Follow-Up (Range) (%)*	Autologous BR	Alloplastic BR	Study Quality Scale
Kuykendall et al., 2018[26]	R	BR by a single surgeon between July of 2011 and July of 2015.	Nipple-sparing mastectomy, delayed reconstruction, radiation therapy, additional flap reconstruction, placement of acellular dermal matrix, and those with incomplete data were excluded. In the DIEP flap group, those with incomplete nipple-sparing mastectomy, delayed reconstruction, radiation therapy, additional flap reconstruction, placement of acellular dermal matrix, and those with incomplete data were excluded. In the DIEP flap group, those with incomplete data.	95 (31)	?	37 DIEP	58 NFS	7
Devulapalli et al., 2018[22]	P	All patients undergoing breast reconstruction performed by three plastic surgeons in our department between November of 2010 and November of 2013. Eligibility criteria included patient age of 18 yr or older, awareness of the nature of their malignancy, and ability to read English.	—	200 (—)	12	118 NFS	75 NFS	7

BR, breast reconstruction; NFS, not further specified; R, retrospective; P, prospective; BMI, body mass index; DIEP, deep inferior epigastric perforator; PTRAM, pedicled transverse rectus abdominis musculocutaneous; FTRAM, free transverse rectus abdominis musculocutaneous; SIE, superficial inferior epigastric; TE, tissue expander followed by implant; DI, direct-to-implant; UMCG, University Medical Center Groningen; SIEA, superficial inferior epigastric artery; TMG, transverse myocutaneous gracilis; LD, latissimus dorsi; TRAM, transverse rectus abdominis musculocutaneous; IO, implant only.
*Follow-up = time between reconstructive surgery and administration of postoperative BREAST-Q.

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Table 2. Patient Characteristics

Reference	Title	Data Available	Age*	BMI*	Smoking (%)†	Bilateral (%)	Immediate (%)	Chemotherapy (%)§	Radiation Therapy (%)§	Complications (%)‖	Comorbidities (%)	Partner (%)¶	Education (%)#	Income (%)**
Santosa et al., 2016[15]	Effect of Patient Age on Outcomes in Breast Reconstruction: Results from a Multicenter Prospective Study	Overall	494 <45 yr (32.3%); 803 = 45–60 yr (52.4%); 234 >60 yr (15.3%)	26.9	41 (2.7)	875 (67)	1429 (93)	460 (30)	273 (17.8)	—	—	—	—	—
		Autologous	—	—	—	—	—	—	—	220 (46.6). of which 131 were major (60)	—	—	—	—
		Alloplastic	—	—	—	—	—	—	—	270 (25.5) of which 225 were major (93%)	—	—	—	—
Dean et al., 2016[16]	A Five Year Experience of Measuring Clinical Effectiveness in a Breast Reconstruction Service Using the BREAST-Q Patient Reported Outcomes Measure: A Cohort Study	Overall	52 (24–82)	—	107 (31.2)‡	—	53 (33)	—	—	—	—	—	—	—
Johnson et al., 2016[17]	Advanced Age Does Not Worsen Recovery or Long-Term Morbidity after Postmastectomy Breast Reconstruction	Overall	60.1 (24–84)	—	—	65 (50%)	—	—	—	—	—	93 (72)	53 (40.8)	20 (15.3)**
Weichman et al., 2015[25]	Patient-Reported Satisfaction and Quality of Life following Breast Reconstruction in Thin Patients: A Comparison between Microsurgical and Prosthetic Implant Recipients	Autologous	47.3 (9.3)	21.2 (1.4)	0	31 (62)	479 (81.5)	25 (30.9)	15 (18.5)	**83 (24)** of which 6 reconstructive failure (0.1)	—	20 (80)	8 (32)	0§§
		Alloplastic	47.6 (9.9)	20.3 (1.4)	26 (7.4)	125 (55.5)	1398 (98.1)	105 (30.1)	81 (23.1)	5 (0.1)	—	66 (61)	52 (48)	4 (3.7)§§
Pusic et al., 2009[10]	Patient-Reported Outcomes 1 Year After Immediate Breast Reconstruction: Results of the Mastectomy Reconstruction Outcomes Consortium Study	Autologous	52.3 (8.6)	28.9 (5.3)	17 (3.5)	—	493 (100)	171 (34.7)	115 (23.3)	184 (37.3) of which 104 major (57%)	—	—	86 (17.5)	149 (13.5)
		Alloplastic	48.9 (10.3)	25.1 (5.0)	27 (2.4)	—	1139 (100%)	309 (27.1%)	128 (11.2)	179 (15.7) of which 107 major (60%)	—	—	403 (35.5)	116 (24.2)

(*Continued*)

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Table 2. *Continued*

Reference	Title	Data Available	Age*	BMI*	Smoking (%)†	Bilateral (%)	Immediate (%)	Chemotherapy (%)§	Radiation Therapy (%)§	Complications (%)‖	Comorbidities (%)	Partner (%)¶	Education (%)#	Income (%)**
McCarthy et al., 2014[24]	Chest and Upper Body Morbidity Following Immediate Postmastectomy Breast Reconstruction	Autologous	52 (25–69)	30.2 (19.3–42.6)	8 (5.7)	15 (20.2)	—	29 (39.1)	‖‖	—	—	—	—	—
		Alloplastic	50 (26–79)	23.9 (17.3–36.6)	0 (0)	66 (46.8)	—	85 (60.2)	‖‖	—	—	—	—	—
Eltahir et al., 2015[21]	Which Breast Is the Best? Successful Autologous or Alloplastic Breast Reconstruction: Patient-Reported Quality-of-Life Outcomes	Autologous	51 (35–78)	26 (20–33)	7 (15.2)	13 (27.7)	17 (36.2)	23 (48.9)	20 (43.5)	14 (29.2) of which 8 major (57%)	11 (23.9)	39 (84.8)	12 (25.5)	—
		Alloplastic	44 (26–62)	23.5 (18–34)	14 (31.8)	30 (66.7)	28 (62.2)	12 (29.3)	6 (13.3)	14 (31.1) of which 10 major (71)	6 (13.3)	38 (84.4)	22 (50.0)	—
Lagendijk et al., 2018[23]	Patient Reported Outcome Measures in Breast Cancer Patients	Overall	55.0 (49.0-60.8)	—	—	—	—	—	—	—	—	—	—	—
Kuykendall et al., 2018[26]	Unilateral versus Bilateral Breast Reconstruction: Is Less Really More?	Overall‡‡	155 <55 yr (51%); 147 >55 (49%)	86 <24.9 (30%); 202 >24.9 (70%); 27.7 (6.0)	—	—	—	—	—	33 (11)	—	—	—	—
Devulapalli et al., 2018[22]	The Effect of Radiation on QoL throughout the Breast Reconstruction Process: A Prospective, Longitudinal Pilot Study of 200 Patients with Long-Term Follow-Up	Overall	49.2 (5.3)	27.7 (6.0)	12 (6)	19 (10)	33 (16.5)	50 (25)	51 (25.5)	—	—	—	—	—
		Autologous	—	—	—	—	—	—	—	37 (31), of which 11 were major (30)	—	—	—	—
		Alloplastic	—	—	—	—	—	—	—	41 (19), of which 29 were major (70)	—	—	—	—

BMI, body mass index.
*Age and BMI median with range, or mean with SD.
†Percentage of current smokers.
‡Percentage of current and reformed smokers.
§During and/or after reconstruction.
‖Percentage of any/overall complications and fraction of major complications which were classified as follows: hospital readmission, surgical exploration, and reconstructive failure.
¶Percentage of women in relationship/married.
#Percentage of women with education >college.
**Percentage of women with annual income <$50,000.
††Percentage of women with annual income <$40,000.
‡‡Overall patient demographics unaccounted for nonresponse and missing data.
§§Percentage of women with income less than $20,000.
‖‖Patients with history of radiation therapy were excluded from study.

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Table 3. BREAST-Q Scores

	Satisfaction with Breasts (%)		Satisfaction with Results (%)		Psychosocial Well-Being (%)		Sexual Well-Being (%)		Chest (%)	
Reference	Alloplastic	Autologous	Alloplastic	Autologous	Alloplastic	Autologous	Alloplastic	Autologous	Alloplastic	Autologous
Santosa et al., 2016[15]	63.3 (18)	69.3 (18.8)	—	—	74.6 (19.3)	77.1 (18.4)	54.1 (21.3)	58.7 (21.6)	—	—
Dean et al., 2016[16]	63.9 (56.35–72.11)	66.9 (62.22–71.63)	—	—	70.5 (61.92–79.66)	73.5 (68.43–78.61)	51.9 (45.12–58.80)	57.2 (51.66–62.73)	72.6 (66.28–78.14)	77.3 (73.70-80.79)
Johnson et al., 2016[17]	—	—	—	—	—	—	—	—	78.4 (16.5)	—
Weichman et al., 2015[25]	63.7 (15.2)	73.8 (19.8)	73.1 (19.1)	76 (27.1)	74.2 (19.1)	82.3 (21.6)	56.7 (21.6)	63.8 (21.7)	—	—
Pusic et al., 2009[10]	64 (16.8)	67.8 (17.2)	—	—	71.8 (19)	74.7 (19.2)	53 (21.1)	55.4 (19.8)	76.7 (14.5)	74.9 (15.1)
McCarthy et al., 2014[24]	—	—	—	—	—	—	—	—	—	—
Eltahir et al., 2015[21]	65.5 (17.55)	75.2 (17.09)	74.5 (19.98)	81.8 (18.69)	77.2 (18.1)	74 (17.8)	61.1 (24.17)	60.9 (20.82)	—	—
Lagendijk et al., 2018[23]	53.8 (16.4)	71.9 (16.4)	—	—	63.5 (19.5)	72.7 (19.1)	52.6 (19.4)	60.2 (19.8)	—	—
Devulapalli et al., 2018[22]	62.5	64	68	75	76	74.5	52.8	56	64	79
Kuykendall et al., 2018[26]	64.5	69.3	71.9	73.6	72.8	77.1	54.3	60	70.3	69.5
Average	62.7	69.8	71.9	76.6	72.6	75.7	54.6	59	72.4	75.2

and the Satisfaction with the Surgeon scales were used in only three studies.[21,25,26] Finally, the Satisfaction with Nipples and the Satisfaction with Medical Care scales were used in only two studies.[21,26]

Outcomes and Meta-Analysis

On average, autologous breast reconstruction scored higher on almost all scales (nine of 10) compared with alloplastic breast reconstruction, ranging between 59 and 91.7 (Table 3). Overall, the scores on Satisfaction with Breasts were good for both reconstruction techniques, but not excellent (range, 62.7 to 69.8). The Satisfaction with Breasts subscale indicated the greatest difference between alloplastic and autologous breast reconstruction and was found significant (mean difference, 6.41; 95 percent CI; 3.85 to 9.24; $Z = 4.44$; $p < 0.001$) but with high heterogeneity ($I^2 = 70$ percent; $p = 0.002$) (Fig. 2). As for the Satisfaction with Results subscale, we found a significantly higher satisfaction in the autologous group compared with the alloplastic group (mean difference, 5.52; 95 percent CI; 1.56 to 9.48; $Z = 2.73$; $p = 0.006$), with no heterogeneity ($I^2 = 0$ percent; $p = 0.72$) (Fig. 3). The Sexual Well-Being subscale displayed the lowest average scores but was significantly higher in the autologous group (mean difference, 3.85; 95 percent CI, 2.35 to 5.35; $Z = 5.03$; $p < 0.001$), with no heterogeneity ($I^2 = 0$ percent; $p = 0.76$) (Fig. 4). The same is true for the difference in the Psychosocial Well-Being subscale (mean difference, 2.64; 95 percent CI, 0.84 to 4.44; $Z = 2.88$; $p < 0.004$), but with little heterogeneity ($I^2 = 23$ percent; $p = 0.24$) (Fig. 5). The overall difference in the Physical Well-Being subscale was significant (mean difference, 3.33; 95 percent CI, 0.18 to 6.48; $Z = 2.07$; $p = 0.04$) but also with high heterogeneity ($I^2 = 85$ percent; $p < 0.001$) (Fig. 6). When looking at the rest of the subscales, no significant differences were found (range, 71 to 92). (**See Figure, Supplemental Digital Content 2**, which shows BREAST-Q subscales, ***http://links.lww.com/PRS/E31***.) Funnel plots were made, and for the subscales Satisfaction with Breasts and Physical Well-Being, the funnel plots showed all studies located near the average. (**See Figure, Supplemental Digital Content 3**, which shows funnel plots of the Physical Well-Being subscale, ***http://links.lww.com/PRS/E32***. **See Figure, Supplemental Digital Content 4**, which shows funnel plots of the Satisfaction with Breasts subscale, ***http://links.lww.com/PRS/E33***.) The separate analyses on the studies with a minimum follow-up of 12 months for the scales with high heterogeneity did not show different results and therefore follow-up does not seem to explain the high heterogeneity among these scales. (**See Figure, Supplemental Digital Content 5**, which shows Satisfaction with Breasts studies, with or

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BREAST-Q Outcomes												
Physical Well-Being			Satisfaction with Nipples (%)		Satisfaction with Information (%)		Satisfaction with Medical Care (%)		Satisfaction with Surgeon (%)		Satisfaction with Office Staff (%)	
General (%)		Abdomen (%)										
Alloplastic	Autologous	Autologous	Alloplastic	Autologous	Alloplastic	Autologous	Alloplastic	Autologous	Alloplastic	Autologous	Alloplastic	Autologous
77.5 (14.3)	77 (15.1)	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	80.5 (15.7)	—	—	—	—	—	—	—	—	—	—
78.8 (14.7)	83.6 (17.8)	—	—	—	69.4 (19.3)	75.6 (19.5)	—	—	84.4 (20.8)	89.6 (20.7)	—	—
—	—	74.5 (19.1)	—	—	—	—	—	—	—	—	—	—
76.5 (16)	82.5 (15.3)	—	—	—	—	—	—	—	—	—	—	—
71.9 (15.06)	77.1 (17.11)	77.4 (23.9)	63.6 (33.99)	65.3 (27.82)	71.4 (15.78)	70.7 (14.61)	85.8 (22.02)	87.5 (18.22)	88.1 (17.29)	87.5 (18.51)	85.7 (18.57)	86.3 (20.05)
64.4 (17.3)	68.1 (16.6)	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	66.9	54.6	71.1	73.9	93.2	95.9	79.4	86	—	—
73.8	77.7	77.5	63.6	59.9	70.6	73.4	89.5	91.7	84	87.7	85.7	86.3

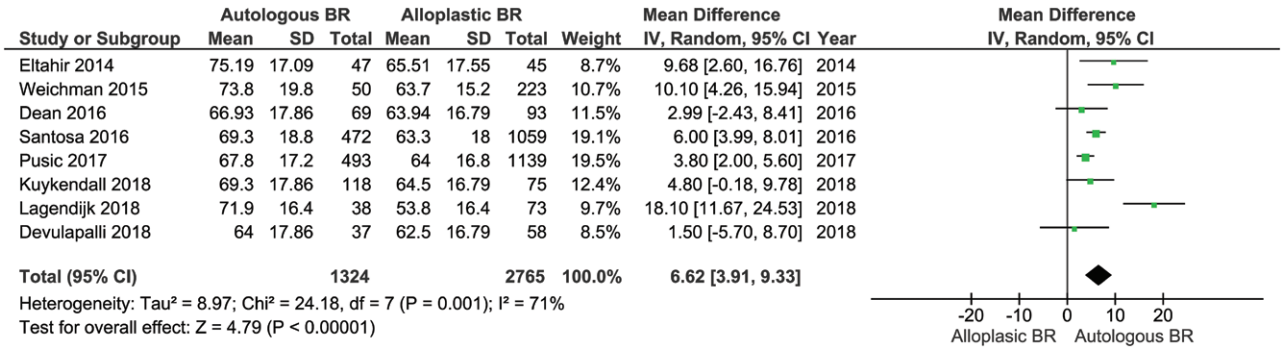

Fig. 2. Satisfaction with Breasts subscale. *BR*, breast reconstruction.

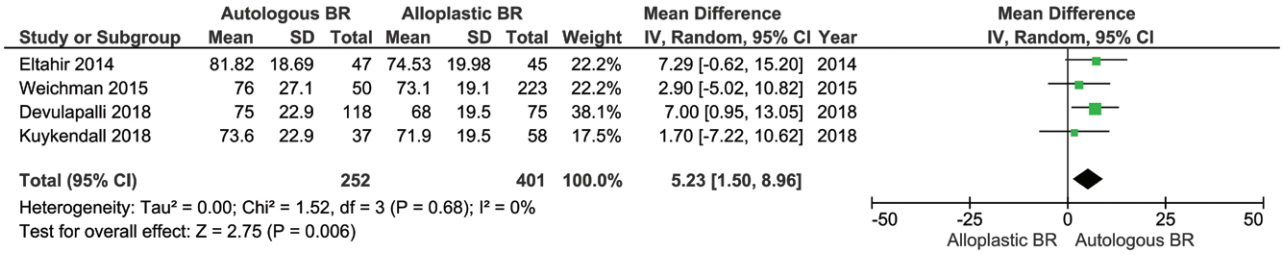

Fig. 3. Satisfaction with Results subscale. *BR*, breast reconstruction.

without minimum follow-up of 12 months, ***http://links.lww.com/PRS/E34***. **See Figure, Supplemental Digital Content 6**, which shows Physical Well-Being for studies with or without minimum follow-up of 12 months, ***http://links.lww.com/PRS/E35***.)

DISCUSSION

This systematic review found superior outcome of the BREAST-Q scores in patients who underwent autologous breast reconstruction compared with women undergoing alloplastic breast

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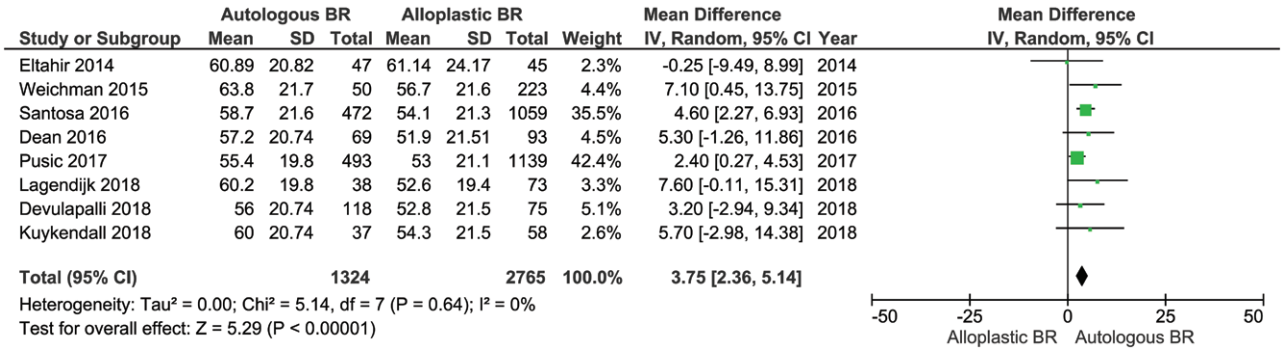

Fig. 4. Sexual Well-Being subscale. *BR*, breast reconstruction.

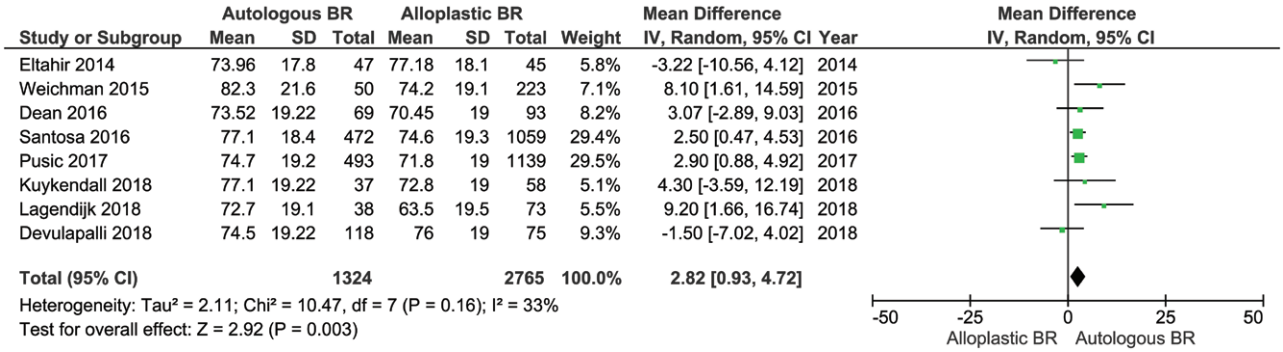

Fig. 5. Psychosocial Well-Being subscale. *BR*, breast reconstruction.

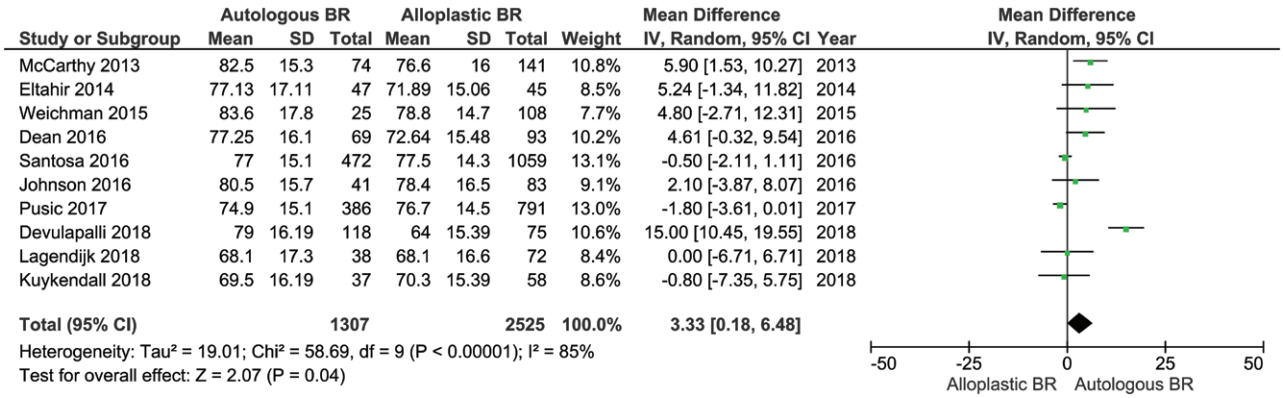

Fig. 6. Physical Well-Being subscale. *BR*, breast reconstruction.

reconstruction regarding satisfaction with breasts, satisfaction with results, sexual well-being, psychosocial well-being, and physical well-being irrespective of the timing of the data collection.

Comparison to the Literature

When evaluating breast reconstruction, where the primary outcome parameter was satisfaction with breasts, Fracon et al. found results similar to those of our review and concluded that autologous breast reconstruction leads to higher patient satisfaction than implant breast reconstruction.[27] Another study found similar results in favor of autologous breast reconstruction.[28] Similarly, Alderman et al., using a generic questionnaire, found that patients 2 years postoperatively continued to be more aesthetically satisfied with autogenous breast reconstruction compared with expander/implant breast reconstruction.[29]

The Physical Well-Being subscale showed the lowest difference between the two groups, but was still highest after autologous breast reconstruction, which is remarkable because autologous breast reconstruction in general imposes a greater physical strain on women compared with alloplastic breast reconstruction. This could be partly

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explained by the finding that the autologous group indeed suffers from more minor complications and secondary corrections compared with the alloplastic group. In contrast, the alloplastic group has a higher incidence of major complications and reconstructive failure (Table 2). Other studies comparing different types of breast reconstruction found similar results.[30,31] In these, multiple months to years had elapsed between surgery and filling out the BREAST-Q, which might have affected the BREAST-Q scores.

It is remarkable that the scores of the breast reconstruction women in this meta-analysis are much higher than those that have been collected with aid of the Army of Women among 1200 women that had not undergone any form of breast surgery. Their mean Satisfaction with Breasts normative score using the BREAST-Q was 58 ± 18.[32] This finding suggests that women with reconstructed breasts are more satisfied with the appearance of their breasts than women with "normal/natural" breasts. However, it may also be that the two groups are not comparable because of selection bias or cultural differences. Comparing the data found in the included studies to normative data collected with aid of the Army of Women might hold a selection bias, as the women included in the Army of Women do not necessarily reflect average healthy women in society. The fact that women with reconstructed breasts score higher on satisfaction with breasts could mean that women appreciate the reconstructed breast more because they have felt the emotional loss of their breast(s) and are grateful for their recovery after breast cancer treatment.

This meta-analysis on the Satisfaction with Breasts and Physical Well-Being subscales showed high heterogeneity (70 percent and 85 percent, respectively). No high heterogeneity was found among the remaining subscales (i.e., Satisfaction with Results, Sexual Well-Being, and Psychosocial Well-Being). Intrainstitutional studies applied their own technique used by their own surgeon, used their own institutional protocols, and treated their own subset of patients, which may cause differences between practices. However, heterogeneity can probably be explained by the different methodologies used between studies. The moment of completion of the postoperative BREAST-Q varied strongly among the studies included in our analyses (Table 1). The two largest studies[10,15] both had fixed follow-up for taking the postoperative BREAST-Q (1 year and 2 years, respectively), in contrast to the other studies, which had a range of follow-up in which the postoperative questionnaires were taken. Besides that, the distribution of subgroup breast reconstruction techniques varied among studies and were not always specified (Table 1). Alloplastic breast reconstruction can be divided into direct implants or tissue expanders followed by implants. Among the autologous group, there too is a variety of techniques available.[33] The quality of life may vary between each breast reconstruction subgroup; therefore, these different definitions can cause heterogeneity. Patient demographics can also cause heterogeneity[34]; the focus of each of the included studies was not always primarily quality of life. Some studies focused on weight, others on age, and others on the administration of radiotherapy. This can cause demographic variety among the studies included in this review and affect heterogeneity. As for publication bias, the funnel plots (**see Figure, Supplemental Digital Content 2**, ***http://links.lww.com/PRS/E31***; **see Figure, Supplemental Digital Content 3**, ***http://links.lww.com/PRS/E32***) were both situated around the average, which suggests that there is probably no or only little publication bias.

Strengths and Limitations

The strength of this meta-analysis lies in its strict work flow and protocol. Furthermore, including only articles in which the BREAST-Q was used provided validated patient-reported data. However, this review has several limitations. No randomized controlled trials were found. Depending on different factors, patients or physicians chose one of the two alternative modes of intervention. Thus, we accepted nonrandomized comparative studies and case series. In addition, only 10 studies were deemed eligible. Furthermore, not all studies used all BREAST-Q scales. Only subscales with data of a minimum of four studies available were used in meta-analyses and discussed in the Results section. The other subscales were added as supplementary data in this review. If all scales had been included in the studies, this would have created more consistency and might have changed our findings. Having said that, the authors acknowledge that it is challenging for all breast reconstruction studies to include all scales instead of focusing on the aim of their studies. In addition, the definition of mixed breast reconstruction, implant plus flap, varied among the studies: some studies defined it as autologous breast reconstruction and others as alloplastic. Most studies did not further specify which subtechniques of breast reconstruction were performed and did not provide BREAST-Q scores per subtechnique. In addition, studies did not report

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information about institutional practices that would have possibly helped explain some of the heterogeneity found among some subscales. Having said this, we also conclude that these interinstitutional differences were not relevant for the subscales Satisfaction with Results, Sexual Well-Being, and Psychosocial Well-Being, given that the I^2 values for these scales were highly homogeneous. Furthermore, at this moment, it is unclear whether women opting for autologous breast reconstruction are equally satisfied before breast reconstruction compared with women opting for alloplastic breast reconstruction. It is possible that, preoperatively, a significant difference in satisfaction with breasts exists between the two reconstruction groups. Also, the timing of reconstruction might be important in this matter. In women undergoing primary reconstruction, their own breast is replaced in one operation by a reconstruction. In secondary reconstruction, women have experienced the meaning of missing a breast, possibly resulting in a better postoperative BREAST-Q score. Finally, most data included in this review were retrieved through retrospective research, which leaves more room for bias.

Implications

This review showed that women scored especially low on sexual well-being, and future research should consider focusing more on this topic because this contributes also to the overall quality of life of breast cancer survivors and women in general.[35] The BREAST-Q might not be the most suitable questionnaire to further evaluate this topic, but it is currently the only instrument in reconstructive breast surgery that meets international standards in terms of development and validation. Overall, we believe there is a strong need for more prospective studies that compare preoperative BREAST-Q data to postoperative data collected at 6 weeks, 6 months, 1 year, and after completion of reconstruction, to find out how satisfaction changes over time. We suggest that the following breast reconstruction subgroups are created: alloplastic reconstruction on the one hand and autologous reconstruction using free flaps on the other. Cases in which an implant is combined with a flap should in our view be considered a subtype of alloplastic breast reconstruction. Only then can we truly understand how satisfaction evolves over time and how the highest satisfaction level can be achieved for women undergoing breast reconstruction. We also would like to encourage future studies with prospective data collection and a more detailed description of breast reconstruction techniques used, to obtain more comparable study outcomes.

CONCLUSIONS

This review showed that women after autologous breast reconstruction were more satisfied and had higher quality of life compared with alloplastic breast reconstruction. Those undergoing autologous breast reconstruction scored higher in almost all BREAST-Q scales compared with alloplastic breast reconstruction, and the greatest difference was seen in Satisfaction with Breasts (mean difference, 6.41; 95 percent CI, 3.85 to 9.24; I^2 = 70 percent). Prospective research implementing preoperative questionnaires using all BREAST-Q scales is sorely needed to provide more conclusive evidence. Preoperative data give insight into the patient's point of view before surgery and will help assess changes in quality of life over time. Such evidence would assist patients taking their share in the decision on which breast reconstruction procedure would provide them with the highest satisfaction and quality of life after breast reconstruction.

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