Clinical results and patient-reported outcomes in breast reconstructive surgery

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CHAPTER 7

Cost-effectiveness of one-stage implant-based breast reconstruction with an acellular dermal matrix versus two-stage expander-implant reconstruction

From a multicentre randomised controlled trial

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ABSTRACT

Introduction Implant based breast reconstruction (IBBR) is the most commonly performed reconstructive procedures and its economic impact is significant. One of the aims of the randomised controlled trial (RCT) was to objectify the hypothesis that direct, one-stage implant-based breast reconstruction (IBBR) with the use of an acellular dermal matrix (ADM) is more cost-effective than two-stage (expander-implant) breast reconstruction.

Methods In this multicentre, open-label RCT, women older than 18 years with breast carcinoma or a genetic predisposition scheduled for skin-sparing mastectomy and immediate IBBR, were randomised to undergo one-stage IBBR with ADM or two-stage IBBR. Duration of surgery, hospital stay and visits for the primary and unplanned procedures were recorded. Costs (in euros) at an institutional level were estimated. Health status was assessed with the EQ-5D-5L questionnaire. This study is registered at Netherlands Trial Register, number NTR5446.

Results Fifty-nine patients (n = 91 breasts) received one-stage IBBR with ADM and 62 patients (92 breasts) two-stage IBBR. Mean operation time in the one-stage group was significantly longer for unilateral (2.52 ± 0.55 vs. 2.02 ± 0.35 hours, $p < 0.001$) and bilateral (4.03 ± 1.00 vs. 3.25 ± 0.58 hours, $p = 0.017$) reconstructions compared to two-stage IBBR. Costs were higher for unilateral (€ 11,752 (95% CI € 9987; € 13,611) vs € 9000 (€ 8551; € 9479), $p = 0.008$) and bilateral (€ 16,714 (€ 14,909; € 18,971) vs € 13,061 (€ 12039; € 14233, $p = 0.001$) one-stage IBBR, with no difference in postoperative health-status between the groups.

Conclusion One-stage IBBR with ADM was associated with higher costs, which was partly caused by the relatively expensive ADM, and comparable health-status, compared to conventional two-stage IBBR.

INTRODUCTION

Worldwide, breast cancer is the most common cancer in women and its global societal and economic burden is enormous.[1, 2] Improving treatment outcomes while controlling costs is a fundamental challenge faced by healthcare systems worldwide.[3] In the United States, the 5-year survival rate of women diagnosed with breast cancer approximates 90%. Presently, there are more than 3.1 million breast cancer survivors in the United States alone.[4] In the U.S, over sixty-thousand new cases of female breast carcinoma in situ are expected to be diagnosed in 2017,5 indicating that the number of breast cancer survivors will progressively increase. Most women diagnosed with breast cancer have to undergo either lumpectomy or mastectomy. Today, in most developed countries breast reconstruction is offered as a standard treatment option after mastectomy, with the aim to improve long term outcomes and quality of life. With more than 100,000 breast reconstructions per year in the U.S., it is one of the most frequently performed reconstructive procedures by plastic surgeons.

There are many surgical options for breast reconstruction. Yet, we are unsure which option is most cost-effective for an individual patient. Implant-based breast reconstruction methods (IBBR) are used in approximately 80% of reconstructions following mastectomy.[6] IBBR is performed either in one or two-stages, with or without the use of an additional tissue matrix. It has been suggested that one-stage reconstruction augmented with an acellular dermal matrix (ADM) is more cost-effective than two-stage IBBR. Only a single procedure and the insertion of a larger breast implant because of enlargement of the subpectoral pocket are advantages of one-stage ADM-assisted IBBR. Improved aesthetic outcome after using an ADM has been reported as an additional advantage. Several studies, which compared the cost-effectiveness of different IBBR methods or IBBR with autologous reconstructions, have reported conflicting data.[7-11] In general, the additional use of an ADM was considered cost-effective. However, in most studies a decision analytic model was used, in which clinical outcomes were based on previously published literature which were incorporated in the analyses with various probabilities.[8, 9, 11, 12] This method is at risk for selection bias, as clinical outcomes after breast reconstruction vary considerably, with complication rates ranging from 4.0% to 50.0%.[13-17]

In the present prospective randomised controlled study, the Breast Reconstruction In One Stage (BRIOS) study, we compared the cost-effectiveness of one-stage ADM-assisted (Strattice™) IBBR with two-stage expander/

implant breast reconstruction. The BRIOS study is an open-label phase IV, prospective, multicenter randomised controlled trial performed in eight hospitals in the Netherlands.[18]

METHODS

Study design and patients

The Breast Reconstruction In One Stage (BRIOS) study was a prospective, multicentre randomised controlled trial. Eligible women were older than 18 years with breast carcinoma or a gene mutation linked to breast cancer, who intended to undergo skin-sparing mastectomy and immediate IBBR. Women were randomly assigned to undergo one-stage IBBR with ADM (group 1) or two-stage IBBR (group 2).

The objective of the study was to compare outcomes of one-stage implant-based breast reconstruction combined with ADM (Strattice, LifeCell, Branchburg, NJ, USA) (one-stage IBBR with ADM) with outcomes of conventional two-stage tissue expander/implant BR (two-stage IBBR). The primary endpoint of the BRIOS study was health-related quality of life assessed with the BREAST-Q at one year after placement of the definite implant. The full study design, methodology and surgical techniques were described previously.[18] Here we report on the secondary outcome cost effectiveness.

The protocol was approved by the institutional review boards from each study center. All patients provided written informed consent. This paper reports the results of NTR5446 preregistered study, which can be accessed at the Netherlands Trial Register here http://www.TrialRegister.nl. The BRIOS study was performed in accordance with the Declaration of Helsinki and guidelines for Good Clinical Practice.

Outcome measures

We recorded the following data: duration of surgery in hours, hospital stay in days, the number of outpatient visits for expander fill in case of a two-stage procedure, and the number of additional outpatient visits if a complication occurred. These data were collected for the primary breast reconstruction procedure, for the operations due to surgical complications, and for secondary reconstructions in case of explantation. The duration of surgery was defined as the time from first incision to closure of the wound.

Cost calculation

Direct costs were calculated, including all expenses listed in Table 1. First, we calculated costs of the primary procedures only. Subsequently, we calculated costs for the breast reconstruction including subsequent operations for surgical complications and secondary procedures. We did not take procedures for cosmetic improvements into account. The analyses were performed separately for unilateral and bilateral reconstructions. Costs (in euros) were estimated based on cost statements from the financial department of the VU University Medical Center (VUmc). An overview of cost prices used in the calculations is shown in Table 1. The operation room (OR) costs included materials, OR and anaesthesia care team and cleaning of the OR. The surgeons' fee and costs of the implants (tissue expander, breast prosthesis and ADM) were calculated separately. The calculation of the costs was based on a single surgeon performing each surgery.

Patient reported outcomes

Patient reported outcomes were measured with the EQ-5D-5L questionnaire, a standardised measure of health status, assessing the following 5 dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each domain has 5 levels: no problems (1), slight problems (2), moderate problems (3), severe problems (4) and extreme problems (5). Answers were converted into index values using the SPSS syntax file which can be ordered from the EuroQol Office, enabling us to compare our results to the reference values.19 On the EQ-VAS, self-rated health was measured using a 20 cm vertical line with scores ranging between 0, "the worst health you can imagine" and 100, "the best health you can imagine".

Statistical analyses

Descriptive statistics were used for all variables. The differences between groups in duration of surgery and number of hospital visits in case a complication occurred, were assessed with Student's t-tests. For the differences in hospital stay (in days), Mann-Whitney U tests were used. Bootstrap analysis was performed to calculate the 95% confidence interval of the costs. The difference in costs, EQ-5D-5L index values and EQ-VAS were determined with Student's t-test.

Procedure	Costs (in euros)
Hospital visits	
First outpatient visit	€ 130
Regular outpatient visit	€ 70
Surgery* (per hour)	€ 1,290
Surgeons' fee (per hour)	€ 150
Hospital admission	
Day care patient	€ 400
Inpatient (per day)	€ 550
Materials	
Tissue expander	€ 530
Breast prosthesis	€ 530
ADM (Strattice)	€ 2,370

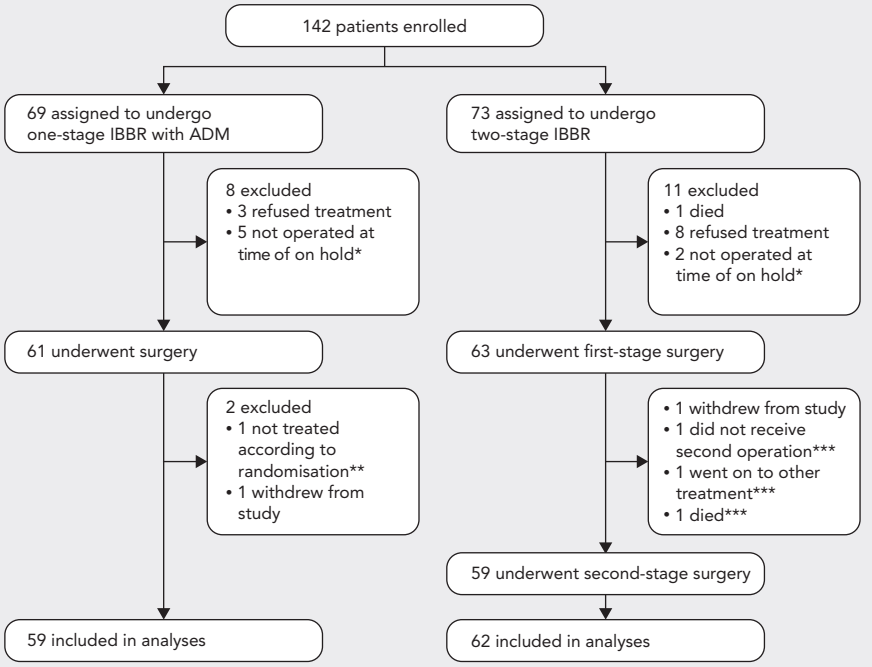
* Including all materials, OR and anaesthesia care team and cleaning of the OR, excluding surgeon's fee.

Table 1 Cost prices used

RESULTS

Patient characteristics

In total, 142 women were enrolled and randomised to undergo one-stage IBBR with ADM (59 women) or two-stage IBBR (62 patients) (Figure 1). Comprehensive patient demographics were published previously.[18] The mean follow up after the first surgery was 37 months for the one-stage IBBR with ADM and 35 months for the two-stage IBBR group (Table 1). In the one-stage group, significantly more complications (39.6% vs. 14.1% of the reconstructions) occurred, which resulted in higher reoperation (34.1% vs. 13.0%) and explantation (27.5% vs. 4.3%) rates (Table 2).[18]



IBBR = implant-based breast reconstruction. ADM = acellular dermal matrix. * The ethics committee put surgery onhold before these operations. ** Treatment was two-stage IBBR because of the surgeon's decision during surgery, and the patient was analysed as part of the two-stage IBBR group. *** Included in final analysis

Figure 1 Inclusion of patients

Primary breast reconstruction procedure

Operation time for the primary surgery was significantly longer in the one-stage IBBR with ADM compared to the two-stage reconstruction group, both for unilateral (2.52 ± 0.55 hours vs. 2.02 ± 0.35 hours, $p < 0.001$) and bilateral (4.03 ± 1.00 hours vs. 3.25 ± 0.58 hours, $p = 0.017$) reconstructions (Table 3). Duration of hospital stay after primary surgery was not significantly different between the two groups. When combining the two operations from the two-stage group, total operation time for bilateral two-stage reconstructions (4.49 ± 1.11 hours, $p = 0.013$) was longer than for bilateral one-stage reconstruction (4.03 ± 1.0 hours, $p = 0.013$). The total median hospital stay for both unilateral (5.0 – 3;10 days) and bilateral two-stage reconstructions (5.0 – 2;11) were longer than those for one-

Table 2 Surgical complications, reoperations and removal of implant

	Unilateral		Bilateral	
	One-stage IBBR + ADM (n = 27 patients)	**Two-stage IBBR (n = 32 patients)**	**One-stage IBBR + ADM (n = 32 patients; 64 reconstructions)**	**Two-stage IBBR (n = 30 patients; 60 reconstructions)**
Surgical complications	37.0% (n = 10)	12.5% (n = 4)	28.1% (n = 18; n = 15 patients)	11.7% (n = 7; n = 6 patients)
Haematoma	14.8% (n = 4)	3.1% (n = 1)	1.6% (n = 1)	1.7% (n = 1)
Seroma	-	-	-	1.7% (n = 1)
Burn wound	-	-	-	1.7% (n = 1)
Blister	-	-	-	1.7% (n = 1)
Redness without signs of infection	11.1% (n = 3)	3.1% (n = 1)	3.1% (n = 2)	-
Wound infection	-	3.1% (n = 1)	3.1% (n = 2)	1.7% (n = 1)
Skin necrosis	-	-	12.5% (n = 8)	1.7% (n = 1)
Wound dehiscence: exposure				
ADM	11.1% (n = 3)	NA	3.1% (n = 2)	NA
ADM and implant	-	NA	3.1% (n = 2)	NA
Unknown	-	-	1.6% (n = 1)	-
Suspected perforation of expander	NA	3.1% (n = 1)	NA	1.7% (n=1)
Reoperations				
Haematoma evacuation	7.4% (n = 2)	3.1% (n = 1)	1.6% (n = 1)	5.0% (n = 3)
Excision of burn wound	-	-	-	1.7% (n = 1)
Botox injection	-	3.1% (n = 1)	-	-
Necrosectomy	-	-	1.6% (n = 1)	1.7% (n = 1)
Removal of				
Tissue expander	NA	6.3% (n = 2)	NA	1.7% (n = 1)
Implant	3.7% (n = 1)	-	14.1% (n = 9)	1.7% (n = 1)
ADM	-	NA	3.1% (n = 2)	NA
ADM + implant	18.5% (n=5)	NA	10.9% (n = 7)	NA

Reported values are percentages (number). IBBR = implant-based breast reconstruction. ADM = acellular dermal matrix. NA = not applicable.

Table 3 Operation details for both primary breast reconstructive procedures (per patient)

	Unilateral			Bilateral		
	One-stage IBBR + ADM (n = 27)	**Two-stage IBBR (n = 32)**	**p-value**	**One-stage IBBR + ADM (n = 32)**	**Two-stage IBBR (n = 30)**	**p-value**
Operation time (h.min)						
Surgery 1	2.52 ± 0.55 (mv n = 2)	2.02 ± 0.35 (mv n = 2)		4.03 ± 1.00	3.25 ± 0.58 (mv n = 1)	
Surgery 2	n.a.	1.02 ± 0.40 (mv n = 2)		n.a.	1.11 ± 0.33 (mv n = 8)	
Total	2.52 ± 0.55	3.09 ± 0.55	p = 0.298	4.03 ± 1.00	4.49 ± 1.11	p = 0.013
Hospital stay (days)						
Surgery 1	3.0 – 2; 8	3.0 – 2; 8		4.0 – 2; 11	3.0 – 2; 6	
Surgery 2	n.a.	2.0 – 1; 4		n.a.	2.0 – 1; 3 (mv n = 2)	
Total	3.0 – 2; 8	5.0 – 3; 10	p = 0.002	4.0 – 2; 11	5.0 – 2.0; 11.0	p = 0.008
Number of expander fillings	n.a.	5.27 ± 2.55		n.a.	6.17 ± 2.55 (mv n = 1)	
Materials	Implant (n = 1) ADM (n = 1)	Expander (n = 1) Implant (n = 1)		Implant (n = 2) ADM (n = 2)	Expander (n = 2) Implant (n = 2)	

Reported values are mean ± standard deviation or median – minimum; maximum, mv = missing value.

stage reconstructions (unilateral 3.0 – 2;8, bilateral 4.0; 2-11, $p < 0.05$). The average total direct costs of a unilateral one-stage IBBR (€ 9052 (95% CI € 8409; € 9815) was comparable with the costs of unilateral two-stage reconstruction (€ 8940 (€ 8445; € 9537), $p = 0.815$) but higher for bilateral reconstruction (one-stage IBBR € 14,364 (€ 13,672; € 15,088 vs. two-stage IBBR € 12,566 (€ 11,790; € 13,471), $p = 0.004$), due to higher implant costs in the one-stage group.

Additional procedures

Patients who had had a complication visited the outpatient clinic more often if they underwent one-stage IBBR compared to those who underwent two-stage reconstruction. This difference was statistically significant for bilateral reconstructions (6.00 ± 3.30 vs 2.67 ± 2.73, $p = 0.042$) (Table 4).
In the one-stage group, nine patients with unilateral reconstructions and 13 patients with bilateral reconstructions underwent one or more additional surgeries. In the two-stage group, respectively two and five patients underwent one or more reoperations (Table 3).

Patients with a failed unilateral reconstruction mainly were converted to an autologous reconstruction (n = 4 in the one-stage group, n = 2 in the two-stage group). Patients with a failed bilateral reconstruction were salvaged with either an implant reconstruction or a combination of an implant and autologous tissue. Additional implant materials that were needed in case of a reconstruction were tissue expanders (one-stage n = 18, two-stage group n = 1), breast implants (one stage n = 17, two-stage group n = 1) and another ADM (one stage n = 1). In the unilateral-two stage group, two tissue expanders were replaced by autologous flaps (Table 4).

After combining all costs including complications and the salvage reconstruction method, the average costs per patient were higher in the one-stage compared to the two-stage group for both the unilateral (one-stage € 11,752 (95% CI: € 9987; € 13,611) versus two-stage € 9000 (95% CI: € 8551; € 9479), $p = 0.008$) and bilateral reconstructions (one-stage € 16,714 (95% CI: € 14,909; € 18,971) versus two-stage € 13,061 (95% CI: € 12039; € 14233, $p = 0.001$).

	Unilateral		Bilateral	
Number of complicated cases	One-stage IBBR + ADM (n = 10)	Two-stage IBBR (n = 4)	One-stage IBBR + ADM (n = 15)	Two-stage IBBR (n = 6)
Additional outpatient visits (n)	3.10 ± 1.85	2.75 ± 2.22	6.00 ± 3.30	2.67 ± 2.73
Additional reoperations (n patients)	2.0 ± 0.50 (n = 9)	2.0 ± 2.65 (n = 3)	2.92 ± 1.19 (n = 13)	1 (n = 5)
Additional operation time (h.min)	1.19 ± 1.42	2.14 ± 2.14	1.0 ± 0.21	0.45 ± 0.17
Additional hospital stay (days)	3.63 ± 2.96	4.83 ± 2.32	2.51 ± 1.52	3.0 ± 2.83
Additional material	Expander (n = 2), implant (n = 2)	Expander removal (n = 2)	Expander (n = 16), implant (n = 15), other ADM (n = 1)	Expander (n = 1), implant (n = 1)

Reported values are mean ± standard deviation.

Table 4 Additional operation details for both breast reconstructive procedures in complicated cases only (per patient)

Health outcomes

The EQ-5D-5L questionnaire was preoperatively filled out by 63 patients (52.1%, mean score 0.857 ± 0.141) and postoperatively by 92 patients (76.0%, 0.915 ± 0.097). In general, higher postoperative scores for all groups were found (Table 5). Postoperative EQ-5D-5L or EQ VAS scores for both unilateral and bilateral reconstructions were not significantly different between one-stage IBBR with ADM and two-stage IBBR.

Table 5 Mean pre- and postoperative health status per patient (measured with the EQ-5D-5L)

	Unilateral			Bilateral		
	One-stage IBBR + ADM (n = 27)	Two-stage IBBR (n = 32)	p-value	One-stage IBBR + ADM (n = 32)	Two-stage IBBR (n = 30)	p-value
Preoperative						
EQ-5D-5L	0.78 ± 0.17 (mv n = 10)	0.86 ± 0.12 (mv n = 15)	0.93 ± 0.08 (mv n = 17)	0.86 ± 0.14 (mv n = 16)		
EQ VAS (0-100)	69.0 ± 17.4 (mv = 10)	78.8 ± 17.9 (mv n = 15)	89.0 ± 9.6 (mv n = 17)	74.9 ± 11.2 (mv n = 16)		
Postoperative						
EQ-5D-5L	0.89 ± 0.08 (mv n = 5)	0.93 ± 0.10 (mv n = 8)	p = 0.220 (mv n = 6)	0.92 ± 0.11 (mv n = 10)	0.93 ± 0.08	p = 0.648
EQ VAS (0-100)	79.7 ± 12.9 (mv n = 7)	79.9 ± 14.8 (mv n = 14)	p = 0.967 (mv n = 7)	85.4 ± 11.5 (mv n = 13)	82.3 ± 9.4	p = 0.354

Mv = missing value.

DISCUSSION

In the present prospective randomised controlled trial we compared the cost-effectiveness of one-stage ADM-assisted IBBR with two-stage IBBR. The hypothesis that ADM-assisted one-stage IBBR is more cost-effective than two-stage IBBR could not be confirmed. In our setting, the direct costs of one-stage IBBR with ADM were higher compared with two-stage reconstruction, while health outcomes did not differ between groups.

The way in which health care is financed, differs considerably between countries and health care costs can be calculated from various viewpoints. In the Netherlands, all citizens have mandatory health insurance, which is partly sponsored by the government. Reimbursement by health insurers is based on Diagnosis Related Groups (DRGs) using average costing and therefore reimbursement amounts do not reflect actual costs of specific procedures, which is similar to payment systems of many other countries. This implies that the sum reimbursed is payable regardless of the actual costs to the hospital providing the relevant care. If we want to compare costs of breast reconstruction with and without the additional use of ADM, it seems inappropriate to use reimbursement amounts, when these do not reflect the actual costs associated with its use. Even if ADM would be separately reimbursed, this may not reflect the actual costs. For example, Krishan et al. reported that a large discrepancy exists between the actual cost of ADM ($ 4890) and its reimbursement ($ 214.10). Therefore, in the current study costs were calculated from a hospital perspective. This way of calculating costs, however, is also not without problems, since costs may differ considerably across institutions, i.e. costs of overhead, implant costs, personnel required, financing strategies, or private interests can all vary. For this reason, we reported the outcomes of underlying variables as well (operation time, length of stay etc.) in order to enable comparison with other studies and to allow for cost calculations using different tariffs.

Our results indicate that from an institutional perspective costs of one-stage IBBR with ADM reconstruction are higher than those of two-stage reconstruction, while reimbursement for the one-stage reconstruction is lower. This was true when only the primary procedure was taken into account. The difference in costs between the two methods increased when the costs of additional procedures following surgical complications were

included as well. The major cost factors contributing to this difference were 1) price of the implant material and, 2) higher costs due to a higher complication rate.

Previous authors have used mixtures of perspectives to estimate costs, for instance, using a third party payer perspective with supplemental costs of the use of ADM added in their calculations. Only a few authors reported on costs of ADMs in one-stage implant-based breast reconstruction.[10-12, 20] None of these studies were based on prospectively measured data, but costs were derived theoretically adopting a third-party payer perspective, and analyses were usually combined with literature reviews to estimate complication rates. De Blacam et al., using this method, compared one-stage IBBR with ADM, with two stage IBBR with and without ADM.[11] They reported that ADM-assisted one-stage IBBR was the least expensive approach, also if they included incremental costs of complications. The probability of complications was based on previously published literature.[11] However, they only adjusted for the extended operation length in case an ADM was used and did not include the material costs of ADM. The authors did note, however, that Medicare reimbursement of breast reconstruction with ADM is falsely low and that the relative increase in expense incurred by the use of ADM is substantial when extrapolated nationwide, while the excess costs associated with ADM is amplified by the higher incidence of complications associated with its use. Johnson et al. also compared ADM-assisted one-stage IBBR with conventional two-stage IBBR.[10] They used retrospective data of 24 patients in the one-stage and 22 in the two-stage group to assess surgery related variables and complications. Costings were based on the tariffs governing reimbursement in the NHS in England and the actual costs of ADM were added to their cost calculations. Because, in contrast to actual costs, tariffs in England are equal for unilateral and bilateral procedures, this gives a rather skewed picture, where one-stage IBBR seems less costly in unilateral cases, but more costly in bilateral cases compared with two-stage IBBR.[10] In another retrospective cohort-study no significant cost differences between two-stage IBBR and one-stage ADM-assisted IBBR were reported, but details regarding the perspective and methods to calculate costs were lacking.[20] In a Canadian study, costs of direct-to-implant with AlloDerm reconstruction were compared to two-stage non-AlloDerm reconstruction.[12] The payment system in Canada was not based on DRGs, and costs form the third-party payer perspective corresponded closely to direct costs from the hospital perspective. Expected

costs were calculated with a decision analytic model using data from previous literature. Based on similar complication rates in both groups and an assumed 10% lower capsular contraction in the one-stage group, expected costs of one-stage reconstruction were lower. They showed that total costs are sensitive to the price of the ADM and operation time, where variation in these factors may tip the balance of cost advantage between the two procedures.[12]

ADMs are relatively expensive with reported prices of biological ADMs varying from £ 1292 (≈ € 1449) to $ 4890 (≈ € 4212).[8, 10-12] In the present study in a Dutch hospital setting, the costs of an ADM in a one-stage procedure outweighed the costs of additional time of surgery in a two-stage procedure. With costs of the implant material and costs of overall surgical time being the primary differentiating cost drivers, the costs of one ADM (€ 2,370, unilateral) corresponded to the costs of over 1.5 hours of surgery (including surgeons' fee).

Still, a more costly procedure may be justifiable if it creates more value for the patient. In order to assess whether a procedure is cost-effective, it is necessary to determine the actual costs of the procedure and its value with regard to health outcomes. It has been suggested that the use of ADM in breast reconstruction gives aesthetically better results and that it reduces capsular contracture rates. For instance, Krishan et al. concluded that the use of ADMs in two-stage IBBR was cost-effective despite higher costs and a higher complication rate in ADM assisted IBBR.[9] This was based on the assumption that the quality of life is higher in women treated with ADMs, resulting in higher Quality Adjusted Life Years (QALYs). However, this assumption was not based on patient reported outcomes, but on expert opinions of plastic surgeons.[9] Actual data on health-related quality of life after one-stage IBBR with and without the use of ADM were lacking.[14]

In the present study, the patient reported health status as assessed with the EQ-5D-5L was not different between groups. Furthermore, specific patient reported outcomes regarding QOL and Satisfaction were also not different between groups.[21] Based on these outcomes at one year after definite placement of the breast implant, there is no indication to suggest differences in QALYs between the two groups. Hence, this study cannot confirm that one-stage ADM-assisted IBBR is more cost-effective than two stage IBBR.

An improvement of the health status was seen after the reconstruction, as postoperative EQ-5D index values were higher than preoperative values. Remarkably, the postoperative scores in the present study were also higher than the reference values of the Dutch general population, as reported by Versteegh et al (women: 0.858 ± 0.168), indicating the importance of post-mastectomy breast reconstruction to restore emotional health and self-esteem.[19]

This is the first randomised study which compares both costs and health status between ADM-assisted one-stage IBBR and two-stage IBBR. To deal with the unknown distribution, the estimation of costs was done using bootstrapping while no further assumptions were made in the comparison. However, the study has several limitations. Costs were calculated from an institutional perspective. Direct costs may vary considerably between institutions, and should be reassessed for different settings. Also, socioeconomic costs were not taken into account. Another limitation is that not all women completed the EQ-5L-5D, which reduced the statistical power of our analyses. Finally, the follow-up was too short to assess possible differences in capsular contracture rates.

With similar health outcomes and increased costs, ADM-assisted one-stage IBBR was not cost-effective relative to two-stage IBBR. The additional costs of ADM in ADM-assisted one-stage IBBR and increased costs due to higher complication rates exceeded the costs saved by reduced operation times.

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