The Breast 23 (2014) 876–882

Contents lists available at ScienceDirect

The Breast

journal homepage: www.elsevier.com/brst

Original article

An evaluation of resource utilisation of single stage porcine acellular dermal matrix assisted breast reconstruction: A comparative study

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ARTICLE INFO

Article history:
Received 13 June 2014
Received in revised form
5 September 2014
Accepted 22 September 2014
Available online 11 October 2014

Keywords:
Acellular dermal matrix
Breast reconstruction
Resource utilisation
Health-care analysis

ABSTRACT

Objectives: To evaluate resource utilization of single stage porcine acellular dermal matrix (ADM) assisted breast reconstruction compared with tissue expander (TE), latissimus dorsi flap and implant (LD/I) and latissimus dorsi flap and TE (LD/TE) reconstructive techniques.
Materials and methods: Clinical data was collected for length of stay, operative time, additional hospitalisations and operative procedures, and outpatient appointments for 101 patients undergoing unilateral implant based breast reconstruction. Resources utilised by ADM (Strattice Reconstructive Tissue Matrix™) patients were analysed and compared to the resource usage of traditional techniques.
Results: 25 patients undergoing single stage ADM (*ADM/I*) were compared with 27 having *TE,* 32 having *LD/I* and 17 having *LD/TE* reconstructions. Follow up was 24 months. Compared to *TE*, *ADM/I* had similar length of stay and operative time, lower rate and number of additional procedures, fewer, shorter re-admissions ($p < 0.05$) and fewer appointments ($p < 0.05$). Compared to *LD/TE*, *ADM/I* had shorter length of stay and operative time ($p < 0.05$), lower rate and number of additional procedures, fewer, shorter re-admissions ($p < 0.05$) and fewer appointments ($p < 0.05$). Compared to *LD/I*, *ADM/I* had shorter length of stay ($p < 0.05$) and operative time ($p < 0.05$), fewer appointments, similar rate and number of additional procedures but required more and longer re-admissions.
Conclusion: In our experience, unilateral single stage *ADM/I* was associated with fewer resources utilised in comparison with two staged *TE* and *LD/TE* reconstructions in both complication-free and complicated settings over a 24-month period, despite requiring aesthetic revision in 60.9% of patients. Compared to LD/I, resource utilisation was commensurate in complication-free and complicated settings.

Introduction

Aesthetic outcomes of implant based breast reconstruction have been improved with the introduction of the Acellular Dermal Matrix (ADM) assisted technique [1–5]. Since the first report of ADM assisted breast reconstruction in 2005 [6], reconstruction with ADM has been globally adopted with constantly increasing case numbers [1, 7–9]. Aside from improved aesthetic outcome, which is partially attributable to providing better inframammary control [3, 5], ADM assisted breast reconstruction carries many advantages: reduced outpatient visits [10] due to larger intraoperative [3, 10, 11] and subsequently less postoperative expansions [1, 3, 10, 12], and fewer revision surgeries [2, 12–15], partially as a result of a lower capsular contracture rate [1, 2, 4–7, 14–21]. Furthermore, ADM successfully allows single stage reconstruction, eliminating the need for a second stage operation to recreate the breast mound [1, 4, 6–8, 19–23].

Nonetheless, the access and use of ADM remains restricted in various institutions due to the associated high material cost [3, 10, 14, 24]. With, to our knowledge, only eight publications discussing costs of ADM assisted implant based breast reconstruction since 2010 [1, 10, 12–14, 22, 24, 25], there is lack of evidence related to resource utilisation. The purpose of this analysis was to identify and

Abbreviations: ADM, acellular dermal matrix; TE, tissue expander; LD, latissimus dorsi flap; LD/I, LD and implant; LD/TE, LD and tissue expander; LOS, length of stay; FU, follow up; ANC, axillary node clearance.

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http://dx.doi.org/10.1016/j.breast.2014.09.008
0960-9776/

compare the resource utilisation of our experience with unilateral single stage porcine ADM assisted breast reconstruction compared to two-staged tissue expander (TE) and Latissismus Dorsi Flap (LD − Implant and TE based) techniques. As the first analysis to solely provide an overview of the resources utilised for single stage ADM BR, we intended to explore whether the cost of ADM justifies its use in implant-based reconstruction compared to traditional techniques.

Patients and methods

We performed a retrospective single centre cohort study of patients who underwent unilateral implant-based reconstruction between 2006 and 2011 at our institution, the NHS Trust of Guy's and St. Thomas'. Patients included in the study were: single stage ADM (ADM/I), non-ADM two staged TE, LD + Implant (LD/I) and LD + TE (LD/TE).

Breast surgeons performed skin- or nipple-sparing mastectomy. Patients were offered single stage ADM if they opted to keep a breast size similar to the preoperative size. The final decision was made intraoperative depending on skin-flap vascularity. ADM reconstruction was performed in accordance with previously explained techniques [26]. The ADM used in this study was Strattice™ Reconstructive Tissue Matrix (LifeCell Corporation, Branchburg, NJ). TE reconstruction involved total or partial muscular coverage with pockets created by the pectoralis major or serratus anterior muscles. LD flaps were raised simultaneously in the lateral decubitus position while mastectomy was performed.

By not focussing on actual costs generated, but by recording and comparing resources utilised, including the initial operation, additional hospitalisations and operative procedures (recorded separately for complications and completion of reconstruction), outpatient appointments, seroma drainages and complication rates, we hope to provide a globally reproducible overview, which is applicable to different countries and institutions. This data, as well as clinical data, was extracted from patient notes and electronic hospital databases. No data was collected on patient satisfaction, quality of life or aesthetic outcome. The patient related variables identified include age, body mass index (BMI), indication for surgery, BRCA status, comorbidities (smoking, diabetes, hypertension, use of systemic steroids/immunosuppression) and adjunctive therapy use (radio- and/or chemotherapy). The follow up (FU) was set at 24 months for all patients. We consider this time period substantial for obtaining long-term results and covering the relevant resource usage for a valid comparison.

Four patients underwent simultaneous contralateral mastectomy and reconstruction. However, the contralateral reconstruction differed from the ipsilateral reconstruction, which led to inclusion in the study. These patients, as well as patients undergoing delayed reconstruction, contralateral augmentation and contralateral flaps were excluded from calculations regarding operating times and length of stay, so as to allow equal analysis. Operating times recorded include the mastectomy time, as it was not possible to distinguish between mastectomy and reconstructive time. Additionally, for calculations regarding length of stay, the groups were divided into two time periods, as in-patient management of ADM patients was modified with increased experience. Initially, ADM patients were hospitalized until all drains were removed. With increased experience in management, patients were discharged with drains in situ and monitored closely until drain removal. *Early patients* include the first 12 months of patients recruited for each reconstructive group. *Late patients* include all the remaining patients.

Outpatient appointments included in this analysis are those attended in the plastics dressing and outpatient clinics. Due to documentation it was not possible to record expansions separately. ER visits without admission, nipple tattooist visits, oncological and breast surgical FU appointments were not accounted for. No patients were excluded due to incomplete notes/documentation or death prior to the end of FU.

Resource utilisation of single stage ADM assisted breast reconstruction was compared against all other groups. ADM generates an additional acquisition cost, which is not included in the procedure tariff. In this analysis, the only ADM accounted for is that used in the initial operation. Statistical analysis was performed using ANOVA based on ranks, poisson regression, logistic regression and exact logistic regression depending on the type of data. Baseline variables which showed considerable imbalances between reconstruction groups (p-value < 0.10) were used as covariables in the analyses of resource utilization, which were done as multigroup comparisons in a first step. If the overall p-value indicated a trend towards differences between reconstruction groups (p-value < 0.10) pairwise comparisons were performed with a p-value of <0.05 considered significant. No attempt has been made to adjust p-values for multiple testing. All results are hence considered exploratory. Statistical analysis was performed with the SAS 9.2.

Results

Patient characteristics (Table 1)

101 patients who underwent unilateral implant based breast reconstruction at our institution were included: 25 *ADM/I* reconstructions, 27 *TE* reconstructions, 32 *LD/I* reconstructions and 17 *LD/TE* reconstructions (Fig. 1). Patient characteristics are summarised in Table 1. Age, BRCA status, BMI and reason for mastectomy did not differ significantly between the groups ($p > 0.10$).

All further procedures and admissions recorded took place within the 24-month FU period, with the exception of 6 patients, who only underwent the planned 2nd stage procedure 25–48 months after initial reconstruction. Admission and procedure details for these 2nd stage procedures were included to permit equal analysis. 11 patients with *TE or LD/TE* reconstructions did not complete reconstruction: 7 patients declined further surgery, 2 patients suffered implant loss without subsequent reconstruction and 2 died before end of FU.

Further procedures and admissions after initial reconstruction

Table 2 gives an overview of further procedures after the initial reconstruction. Recorded procedures took place in surgery either during an admission or as a day case. 78 patients (78%) underwent 136 further procedures due to complications and for completion of reconstruction.

37 (39.8%) patients had 62 further procedures due to complications. Procedures performed due to complications were defined as: washout/debridement, implant removal, implant replacement, exchange implant for expander with subsequent procedures, flap salvage, haematoma aspiration and VAC application of breast or donor sites. Seroma drainages of the breast and LD donor site performed during outpatient appointments were recorded separately (Table 4), as resource usage is minimal in comparison to procedures in surgery.

64 patients (65.3%) had 74 further procedures for completion of reconstruction. Procedures performed for reconstructive completion were defined as: planned 2nd stage exchange expander for implant or flap reconstruction, exchange of implant, lipofilling, liposuction, fat transfer, nipple-areola-complex reconstruction,