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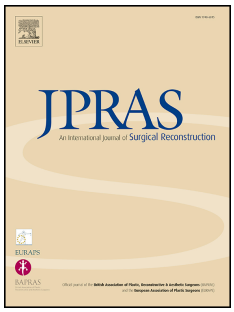


Contralateral breast symmetrisation in unilateral DIEP flap breast reconstruction

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**Title**

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**Running Head**

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**Presentations**

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**Ethical approval**

Not required.

**Keywords**

DIEP; deep inferior epigastric artery perforator flap; breast reconstruction; symmetrisation; symmetrisation; contralateral; balancing; mastopexy; augmentation; mammoplasty; breast reduction; immediate; delayed; microvascular; free flap; complication; complications; adverse outcomes; failure; risk; revision.

**Abstract**

**Introduction:** Women undergoing unilateral DIEP flap breast reconstruction may be offered a contralateral symmetrisation either at the time of reconstruction (simultaneous/immediate) or at a later stage (delayed). Simultaneous contralateral breast symmetrisation may be more beneficial to patients and healthcare institutions by avoiding staged surgery, although there is limited evidence on which to base practice. This deficit formed the rationale for our study. The primary outcome was the overall rate of revision surgery.

**Methods:** Over a 6-year period, this prospective cohort study recorded the demographics, cancer treatments and operative outcomes of all consecutive unilateral DIEP flap breast reconstructions with or without contralateral symmetrising surgery. Patients were categorised into three groups: 1) simultaneous symmetrisation, 2) delayed symmetrisation, and 3) no symmetrisation for comparative analysis.

**Results:** During the study period, 371 women underwent unilateral DIEP flap breast reconstruction; 194 (52.3%) were not symmetrised, 155 (41.8%) were simultaneously symmetrised and 22 (5.9%) underwent delayed symmetrisation. Symmetrising the contralateral breast at the same time as unilateral DIEP flap breast reconstruction increased the mean total operative time by 28 minutes. There were no differences in the rates of peri-operative complications. There were significantly higher rates of all-cause revision surgery (OR 3.97 [1.58, 9.94], p=0.003) in women undergoing delayed symmetrisation, due to higher rates of revision lipomodelling, scar revision and revision contralateral symmetrisation.

**Conclusion:** Simultaneous contralateral breast symmetrisation was associated with a lower risk of all-cause revision surgery. It is safe, beneficial and likely to be more cost-effective for women undergoing unilateral free DIEP flap breast reconstruction.

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## Introduction

Following mastectomy for breast cancer, autologous tissue breast reconstruction offers the greatest level of patient satisfaction[1] and the deep inferior epigastric artery perforator (DIEP) flap is evolving as the ideal option for breast reconstruction[2-5]. To improve aesthetic outcomes after mastectomy, women undergoing unilateral breast reconstruction may be offered a contralateral balancing procedure including breast reduction, mastopexy or augmentation in order to attain symmetrical breast mounds[6]. This may be performed either at the time of reconstruction (immediate/simultaneous symmetrisation) or at a later stage (delayed symmetrisation) and the rising demand for symmetrising procedures are having an increasing impact on the length of waiting lists and breast surgeons' workload[7].

Nowadays, patients and health care providers expect excellent outcomes with fewer risks and lower costs. Unilateral DIEP flap breast reconstruction is well known to be associated with a certain number of secondary procedures to improve outcomes. Revision surgery usually impacts patients' lives and certainly adds demand on stretched health care resources. Therefore, the importance of achieving good outcomes and reducing the need for revision surgery has become an important target to be achieved.

The potential advantages of immediate symmetrisation includes: a single operation and hospital admission with associated morbidity reductions and cost-savings for patients and health services alike[5, 8-10], reduced patient distress due to breast asymmetry[10], as well as the opportunity to sample contralateral breast tissue for occult malignancy[11, 12]. Conversely, some claim that a staged approach may allow better symmetry to be achieved because the procedure is planned to take place once the breast reconstruction is considered stable[13-15]. Overall, the ideal timing of contralateral breast symmetrisation with unilateral autologous tissue breast reconstruction remains controversial[16].

To-date, the literature on unilateral DIEP flap breast reconstruction with contralateral breast symmetrisation is limited[8-10, 13, 16-19] in terms of the potential advantages, patient-reported outcomes and rates of complications; the latter of which formed the rationale for this study.

**Methods and Materials**

Between January 1st 2009 and December 31st 2014, an electronic database was prospectively completed for all consecutive patients undergoing DIEP flap breast reconstruction in a single centre, based on the design of a cohort study. This database was constantly updated and correlated with written and electronic patients' notes to ensure accuracy and completeness of data. Patients were categorised as 'no symmetrisation', 'immediate symmetrisation' or 'delayed symmetrisation' for comparative analysis.

Our primary outcome measure was the rate of all-cause revision surgery between groups. Our secondary outcomes measures included details of the operative technique (mastectomy weight, flap weight, reduction weight and operative time), peri-operative complications requiring a return to theatre and details of requisite revision breast or abdominal surgery.

In our centre, all women undergoing mastectomy for breast cancer are offered reconstruction, with either autologous tissue or implants guided by patient preference and clinical indications[20]. Most of our patients choose a DIEP flap breast reconstruction. We offer contralateral breast symmetrisation either when patients request balancing or when unilateral DIEP flap breast reconstruction will predictably result in a size discrepancy. During the study period, all surgeons offered immediate and delayed balancing surgery with equipoise, in order to allow patients to make a personal decision about the timing of their possible symmetrisation.

We perform unilateral DIEP flap breast reconstruction with two senior surgeons and two trainees. Whether undertaken at the time of reconstruction, or as a delayed procedure, we perform contralateral breast implant augmentation, reduction or mastopexy as required. We use the Wise pattern with supero-medial pedicle and inverted-T scar[21], Hall-Findlay[21] or Lejour[22] vertical scar techniques in descending order of preference. All breast tissue removed from the contralateral breast is routinely sent for histology. When performing unilateral DIEP flap breast reconstruction and immediate contralateral symmetrisation we first reduce the contralateral breast; this better

enables the surgeon to harvest, tailor and inset the DIEP flap to match the reduced breast. We also offer simultaneous nipple reconstruction for women undergoing immediate reconstruction, based on patient's preference. All venous anastomoses were end-to-end with a Synovis® GEM Microvascular Anastomotic COUPLER. Patients with a BMI >30 kg/m$^2$ are counselled regarding the increased overall risk of complications and advised to first lose weight. Similarly, smokers are advised to stop for at least 4 weeks prior to surgery.

Breast cup size was reported by patients and not measured by researchers. An immediate DIEP flap breast reconstruction was performed at the time of mastectomy, whilst a delayed DIEP flap breast reconstruction was undertaken after all cancer related adjuvant treatments were completed. Peri-operative complications were defined as events, which occurred within 30 post-operative days and required a return to theatre. We categorised a partial flap loss as necrosis of the flap, which required sharp debridement but not removal of the entire flap. Revision surgeries were defined as surgical procedures performed after the 30$^{th}$ post-operative day. Revision surgery in relation to symmetrisation procedures was undertaken in the context of patient dissatisfaction and at their request.

Data was input to SPSS v22 (IBM). Continuous variables approximating a normal distribution (according to QQ-plots) are presented by means and standard deviations (SD) and compared with independent samples t-tests or one-way ANOVA with Šídák correction as appropriate. Skewed distributions and integer variables are summarised by medians with interquartile ranges (IQR) and compared with the Mann-Whitney U-test or Kruskal-Wallis test as appropriate. Categorical variables are presented as frequencies (with percentages) and compared with Chi Square test or Fisher's exact test as appropriate. Odds ratios (OR) express the likelihood of adverse outcomes. Significance was set at 5%. Confidence intervals (CI) are generated to the 95% level.

**Results**

During the study period, 371 women underwent unilateral DIEP flap breast reconstruction and of these, 177 (47.7%) underwent contralateral breast symmetrisation. There were 155 (87.6%) immediate and 22 (12.4%) delayed balancing procedures.

Table 1 shows that participants' baseline characteristics were similar and that no given variable biased our decision regarding contralateral symmetrisation. There were no between-group differences in age of menarche or menopause, parity or breast feeding. As expected, women who required contralateral symmetrisation had a statistically higher BMI than women who did not. Similarly, women who required symmetrisation had larger reported breast cup sizes (modal cup size: no symmetrisation group B cup, immediate symmetrisation D cup, delayed symmetrisation D cup, $p<0.001$). The timing of DIEP flap breast reconstruction was not associated with the rate of immediate or delayed contralateral symmetrisation.

We used a Wise pattern with supero-medial pedicle in 138 patients (78.0%), a superior pedicle in 10 patients (5.7%) and an inferior pedicle in 3 patients (1.7%). We performed 17 Hall-Findlay (9.6%) and 9 Lejour (5.0%) vertical scar technique reduction/mastopexy procedures. No contralateral augmentations were performed in this consecutive series.

Table 2 shows that women undergoing simultaneous symmetrisation had a greater median mastectomy weight and required an additional mean 28 minutes of operating time (95% CI 7, 47 minutes). The total operating time range (in hours:minutes) for women who were not simultaneously symmetrised (ie. our time to perform a standard unilateral DIEP flap breast reconstruction) was 3:00 to 10:00, with a mean of 5:51. This was compared to women having an additional simultaneous symmetrisation procedure whose operating times ranged from 3:22 to

12:12, with a mean of 6:19. The median breast reduction weight for the women undergoing simultaneous symmetrisation was no different to women who later underwent (delayed) contralateral breast reduction (306 vs. 289 grams, p=0.442).

Performing an immediate contralateral breast symmetrisation did not increase the pooled risk of peri-operative complications requiring a return to theatre (Table 3). Conversely, we found that delaying the symmetrisation substantially increased the risk of revision surgery on the breasts and abdomen (Table 4).

The SIEV was absent in 13 women (3.5%), preserved but not used in 322 patients (86.8%) and used to augment the venous drainage of 36 (9.7%) DIEP flaps at the time of reconstruction. The internal thoracic vessels (ITV) were the recipients for all flaps except one which was anastomosed to the TD vessels as the ITVs were damaged by radiotherapy. There were no between-group differences for COUPLER™ size, number of perforators per flap, location of the perforators (medial vs. lateral) or the orientation of the arterial anastomoses (end-to-end or end-to-side). Twenty-one women (5.7%) required a bipedicled unilateral DIEP flap breast reconstruction. Of these, 6 had immediate symmetrisation and 2 underwent delayed symmetrisation. Although these figures are limited, they may suggest that the need for contralateral surgery in unilateral bipedicled DIEP reconstruction is reduced, as may be expected.

No patient required a peri-operative blood transfusion. One patient undergoing a delayed unilateral DIEP flap breast reconstruction with immediate contralateral Symmetrisation developed cellulitis of the abdominal wound which required intravenous antibiotics only. There were no occult malignancies found in the contralateral breast tissue in our series.

## Discussion

Few authors have described the outcomes of immediate contralateral breast symmetrisation in association with unilateral free flap breast reconstruction[8-10, 13, 16-19]. Despite delayed symmetrisation being the most popular approach, the limited data on contralateral symmetrisation with unilateral DIEP flap breast reconstruction is largely in favour of simultaneous surgery[8-10, 16-18]. Although we recognise that the current literature is of varying methodological quality, our findings do support the evolving notion that immediate contralateral balancing surgery is safe, beneficial and potentially more cost-effective[5].

The most important finding of our study (and our primary outcome) was the need for all-cause revision surgery; we found a significantly higher rate of revision surgery in women undergoing delayed contralateral symmetrisation. The popular belief is that the contralateral breast should not be symmetrised at the time of reconstruction as the flap should be allowed time to 'settle' before the surgeon attempts to match the native breast. However, we have shown that the incidence of all-cause revision surgery was nearly four times higher in women opting for a delayed symmetrisation (OR 3.97) than those balanced simultaneously (Table 4). We observed independently higher risks of revision breast surgery and abdominal surgery in the delayed symmetrisation group. The higher risks of revision breast surgery in the delayed group was due to higher rates of lipomodelling and revision reduction/mastopexy procedures. This is certainly multifactorial and difficult to explain with the available data. The suggestion that symmetry may be better improved with a simultaneous contralateral breast reduction needs more robust evidence. Unexpectedly, we found that the rates of abdominal scar revisions were also significantly higher in the delayed symmetrisation group but root-cause analysis suggests that the majority of abdominal revision surgeries were simply opportunistic, for example, women requested revision breast surgery and so the surgeon used the opportunity to revise the abdominal scar. On the basis of this finding, we may state that women who have their mastectomy, reconstruction and symmetrisation as one single operation may be happier with their outcome[9] and so, less likely to consult the

surgeon for revision surgery (whether this is related to the quality of the outcome, patient satisfaction or otherwise is still unknown). In support of this hypothesis, Yip et al (2015) showed that in the context of reconstruction and contralateral symmetrisation, breast volume symmetry was not related to satisfaction but most influenced by the pre-operative care as part of the reconstructive 'process'[23]. Further, Huang[8, 9], Inbal[10] and Laporta[19] reported better or comparable satisfaction and aesthetic outcomes with immediate symmetrisation. However, in absence of a patient reported outcomes, we can only speculate on these matters and so share some example cases in Figures 1-5. None-the-less, in the current economic health climate, even if we are unable to fully explain the differences in the number of revision surgery between women undergoing immediate and delayed symmetrisation, we do add to the growing evidence base which suggests that delaying symmetrisation does not appear to be in the best interests of patients. We believe that a delayed approach involves more surgeries which may damage patients' psychosocial wellbeing, affect work and life commitments; increase clinic demand, theatre time, hospital bed occupancy, the length of surgical waiting lists and follow-up appointments.

Nowadays, patients and health care providers have increasing expectations for excellence in aesthetic and psychosocial outcomes from breast reconstruction after mastectomy and this includes breast symmetry. Public expectations come alongside bureaucratic pressures to reduce the cost and morbidity of surgery for such patients. Whilst unilateral DIEP flap breast reconstruction is the gold standard[1, 4], many women do need revision surgery or secondary procedures which are aimed at improving the final result. Currently, nearly 50% of our breast reconstruction patients opt for contralateral balancing surgery[16] and so there is a large scope for additional surgery to be factored into a busy breast reconstruction service. Our results show that immediate breast symmetrisation can be safely undertaken for women with a wide range of breast sizes, including those with a substantial difference between the contralateral breast and the amount of available lower abdominal tissue. In fact, our findings suggest that immediate symmetrisation was performed in patients with a large discrepancy between mastectomy and DIEP

flap weights (approximately 400 grams). Moreover, there was no significant difference in breast reduction weights between those women who underwent simultaneous or delayed contralateral breast reduction. Although the decision to perform contralateral breast symmetrisation involves both the surgeon and patient, surgeons can strongly influence patients' decisions so equipoise is important[24]. Whilst our patients do seem to prefer the option of breast reconstruction and contralateral symmetrisation in a single operation, we cannot exclude the possibility that we biased their decision or that our population is confounded. None-the-less, the recent literature supports simultaneous contralateral symmetrisation and in the absence of results from randomized trials, this is the consensus of the best evidence to-date[8-10, 16-19].

Performing a contralateral breast symmetrisation can increase the average operative time. In our series, this balancing procedure added a mean of 28 minutes to the surgery (with a 95% confidence interval of 7 to 47 minutes). As our DIEP flap breast reconstructions are performed with two senior surgeons and their trainees, this does permit surgery on both the breast(s) and abdomen simultaneously, which may help to explain why the contralateral procedure added such a small amount of extra time. We did not measure the operative time of delayed contralateral symmetrisation, which was an oversight, but secondary procedures in our hands usually take longer than 28 minutes and clearly the overall total anaesthetic time will be substantially greater. Also, it would appear that immediate symmetrisation does not increase the risk of peri-operative complications, which again challenges popular belief and is an important finding. Whilst our approach may not be appropriate for the solo reconstructive breast surgeon, we have shown that simultaneous symmetrisation can be safely performed, with potential reductions in morbidity and costs afforded by avoiding a staged procedure.

When interpreting our findings, limitations must be considered. An oversight in our data collection meant that some variables lacked details, which may have been useful eg. the time interval

between DIEP flap breast reconstruction and delayed contralateral symmetrisation or revision surgeries (we usually wait at least 6 months) and the operative time for the delayed symmetrisation cases. We also cannot be certain whether patients sought revision surgery at other Institutions or privately. We did not measure patient reported outcomes, as this was not our aim and therefore the interpretation of results and application to clinical practice needs more evidence. We undertook multiple statistical comparisons and so the chance of Type 1 error(s) is very high. Given the requisite study design and sample size, some outcomes are likely to be biased and potentially confounded. The example is the higher rate of abdominal donor site revisions in the delayed symmetrised group. Theoretically, the donor site revision rate should have been the same because the same procedure was undertaken (raising a DIEP flap for unilateral reconstruction) in both groups, so whether this represents confounding by unmeasured variable(s)s or simply opportunistic scar revision, during a second stage procedure, is unknown.

Our findings challenge a popular assumption and have shown immediate contralateral breast symmetrisation with unilateral free DIEP flap breast reconstruction to be associated with a lower risk of all-cause revision surgery. Simultaneous contralateral breast symmetrisation can be safe, beneficial and cost-effective with no significant additional risks of complications for women undergoing unilateral free DIEP flap breast reconstruction. Certainly, more research needs to be conducted on this topic and future work should aim to prospectively assess both surgical outcomes (ie. complications as we have done) alongside patient-reported outcomes (ie. satisfaction) in much larger cohorts of women, ideally as multicentred randomised trials.

## Conflicting Interests

None declared.

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## References

1. Craft RO, Colakoglu S, Curtis MS, et al. Patient satisfaction in unilateral and bilateral breast reconstruction. Plast Reconstr Surg 2011;127:1417-24.
2. Gill PS, Hunt JP, Guerra AB, et al. A 10-year retrospective review of 758 DIEP flaps for breast reconstruction. Plast Reconstr Surg 2004;113:1153-60.
3. Lee C, Sunu C, Pignone M. Patient-Reported Outcomes of Breast Reconstruction after Mastectomy: A Systematic Review. J Am Coll Surg 2009;209:123-33.
4. Winters ZE, Benson JR, Pusic AL. A Systematic Review of the Clinical Evidence to Guide Treatment Recommendations in Breast Reconstruction Based on Patient- Reported Outcome Measures and Health-Related Quality of Life. Ann Surg 2010;252:929-42.
5. Haykal S, Guay N. One hundred forty-one consecutive attempts at autologous tissue single-stage breast cancer reconstruction. Ann Plast Surg 2009;63:21-27.
6. Cordeiro PG. Breast reconstruction after surgery for breast cancer. N Engl J Med 2008;359:1590-601.
7. Mathew J, Courtney CA. Symmetrisation procedures in breast reconstruction patients constitute a rising workload in our DGH. Surgeon 2014;12:307-9.
8. Huang JJ, Chao LF, Wu CW, et al. Simultaneous scarless contralateral breast augmentation during unilateral breast reconstruction using bilateral differentially split DIEP flaps. Plast Reconstr Surg 2011;128:593e-604e.

9. Huang JJ, Wu CW, Leon Lam W, et al. Simultaneous contralateral breast reduction/mastopexy with unilateral breast reconstruction using free abdominal flaps. Ann Plast Surg 2011;67:336-42.

10. Inbal A, Gur E, Otremski E, et al. Simultaneous contralateral breast adjustment in unilateral deep inferior epigastric perforator breast reconstruction. J Reconstr Microsurg 2012;28:285-92.

11. Sorin T, Fyad JP, Pujo J, et al. Incidence of occult contralateral carcinomas of the breast following mastoplasty aimed at symmetrization. Ann Chir Plast Esthet 2014;59:e21-8.

12. Petit JY, Rietjens M, Contesso G, Bertin F, Gilles R. Contralateral mastoplasty for breast reconstruction: a good opportunity for glandular exploration and occult carcinomas diagnosis. Ann Surg Oncol 1997;4:511-15.

13. Chang DW, Kroll SS, Dackiw A, Singletary SE, Robb GL. Reconstructive management of contralateral breast cancer in patients who previously underwent unilateral breast reconstruction. Plast Reconstr Surg 2001;108:352-58.

14. Stevenson TR, Goldstein JA. TRAM flap breast reconstruction and contralateral reduction or mastopexy. Plast Reconstr Surg 1993;92:228 -33.

15. Losken A, Carlson GW, Bostwick JI, et al. Trends in unilateral breast reconstruction and management of the contralateral breast: the Emory experience. Plast Reconstr Surg 2002;110:89-97.

16. Chang EI, Selber JC, Chang EI, et al. Choosing the Optimal Timing for Contralateral Symmetry Procedures After Unilateral Free Flap Breast Reconstruction. Ann Plast Surg 2013;74:12-6.

17. Chang EI, Lamaris G, Chang DW. Simultaneous contralateral reduction mammoplasty or mastopexy during unilateral free flap breast reconstruction. Ann Plast Surg 2013;71:144-48.

18. Pauchot J, Feuvrier D, Panouilleres M, Pluvy I, Tropet Y. [Benefit of simultaneous contralateral breast symmetry procedure with unilateral breast reconstruction using DIEP flaps. About 33 cases]. Ann Chir Plast Esthet 2015;60:472-7.

19. Laporta R, Longo B, Sorotos M, Pagnoni M, Santanelli Di Pompeo F. One-stage DIEP flap breast reconstruction: Algorithm for immediate contralateral symmetrization. Microsurgery 2015;36:7-19.

20. National Institute for Health and Care Excellence. Improving Outcomes in Breast Cancer (2010).

21. Hall-Findlay EJ. A simplified vertical reduction mammaplasty: shortening the learning curve. Plast Reconstr Surg 1999;104:748-59; discussion 60-3.

22. Lejour M. Vertical mammaplasty and liposuction of the breast. Plast Reconstr Surg 1994;94:100-14.

23. Yip JM, Watson DI, Tiggemann M, et al. Determinants of breast reconstruction outcome: How important is volume symmetry? J Plast Reconstr Aesthet Surg 2015;68:679-85.

24. Nekhlyudov L, Bower M, Herrinton LJ, et al. Women's decision-making roles regarding contralateral prophylactic mastectomy. Journal of the National Cancer Institute: Monographs 2005;35:55-60.

**Figure Legends**

**Figure 1.** a-c) Pre-operative photographs of a 67 year old woman with 38-D bra-cup size and a right invasive breast carcinoma. d-f) 12-months post right mastectomy (692g) and immediate DIEP flap breast reconstruction (515g) with immediate contralateral breast reduction (184g).

**Figure 2.** a-c) Pre-operative photographs of a 56 year old woman with 40-E bra-cup size and a left sided invasive breast carcinoma. d-f) 36-months post left mastectomy (1323g) and immediate DIEP flap breast reconstruction (872g) with immediate contralateral breast reduction (528g).

**Figure 3.** a-c) Pre-operative photographs of a 57 year old woman with 40-DD bra-cup size and a left sided invasive breast carcinoma. d-f) 8-months post left mastectomy (1083g) and immediate DIEP flap breast reconstruction (940g). g-i) 16-months post delayed contralateral breast reduction (332g).

**Figure 4.** a-c) Pre-operative photographs of a 44 year old woman with 38-D bra-cup size following right mastectomy (826g) and axillary lymph node clearance for breast cancer. d-f) 12-months post right delayed DIEP flap breast reconstruction (582g) with immediate contralateral breast reduction (231g).

**Figure 5.** a-c) Pre-operative photographs of a 57 year old woman with 36-C bra-cup size following left mastectomy (436g) and axillary lymph node clearance for invasive breast carcinoma. d-f) 6-months post left delayed DIEP flap breast reconstruction (414g). g-i) 18-months post delayed contralateral peri-areolar mastopexy.

| Table 1. Baseline Characteristics | | No Symmetrisation (N=194) | Simultaneous Symmetrisation (N=155) | Delayed Symmetrisation (N=22) | p-value |
|---|---|---|---|---|---|
| Age (SD) | | 56.4 (9.08) | 57.3 (9.35) | 54.5 (10.4) | 0.372 |
| BMI (SD) | | 26.0 (2.70) | 27.6 (3.13) | 26.3 (3.76) | 0.006 |
| Smoking history (%) | | 35 (18.0) | 21 (13.5) | 5 (22.7) | 0.444 |
| Lower abdominal scars (%) | | 50 (25.8) | 41 (26.5) | 6 (27.3) | 0.962 |
| Oncological treatment (%) | Neo-adjuvant chemotherapy | 12 (6.19) | 20 (12.9) | 1 (4.55) | 0.062 |
| | Adjuvant chemotherapy | 107 (55.2) | 94 (60.7) | 10 (45.5) | 0.235 |
| | Adjuvant radiotherapy | 95 (49.0) | 83 (53.5) | 10 (45.5) | 0.516 |
| | Adjuvant hormone therapy | 111 (57.2) | 106 (68.4) | 16 (72.7) | 0.044 |
| Breast reconstruction timing (%) | Immediate | 73 (37.6) | 42 (27.1) | 5 (22.7) | 0.070 |
| | Delayed | 121 (62.4) | 113 (72.9) | 17 (77.3) | |

**Table 1.** Baseline characteristics for all patients undergoing unilateral DIEP flap breast reconstruction compared with one-way ANOVA and Šídák correction.

| Table 2. Operative Variables for Women Undergoing Unilateral DIEP Flap Breast Reconstruction | Without Simultaneous Symmetrisation (N=216) | With Simultaneous Symmetrisation (N=155) | p-value |
|---|---|---|---|
| Mean Total Operative Time In hours:mins (SD) | 5:51 (1:22) | 6:19 (1:30) | 0.006 |
| Median ischaemia time in minutes per DIEP flap (IQR) | 32.0 (17.0) | 30.0 (15.0) | 0.309 |
| Median mastectomy weight in grams per breast (IQR) | 568 (290) | 862 (491) | <0.001 |
| Mean DIEP flap weight in grams per flap (SD) | 625 (200) | 646 (174) | 0.318 |

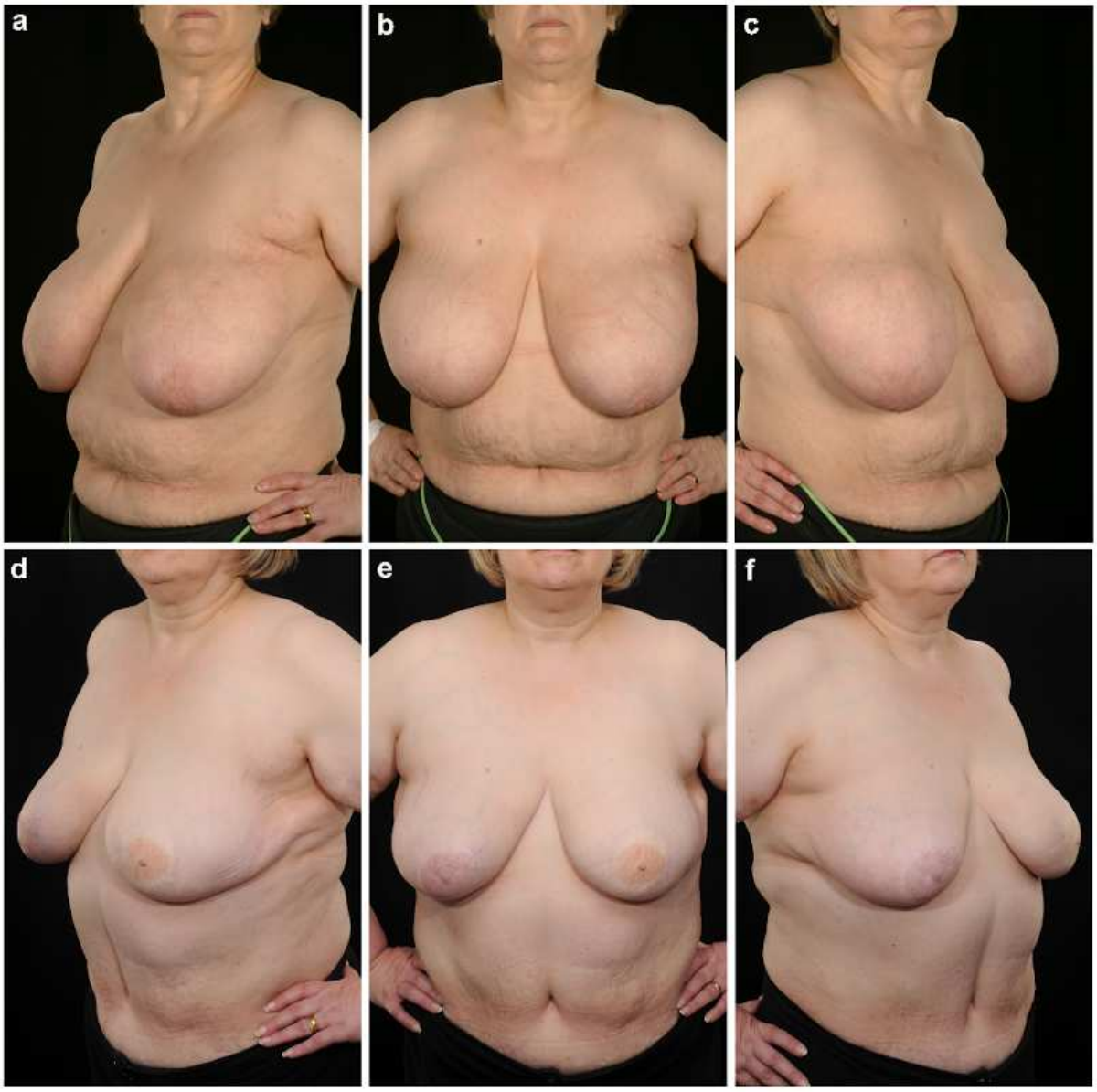
**Table 2.** Operative variables for women undergoing DIEP flap breast reconstruction, grouped according to whether they had simultaneous symmetrisation or not.

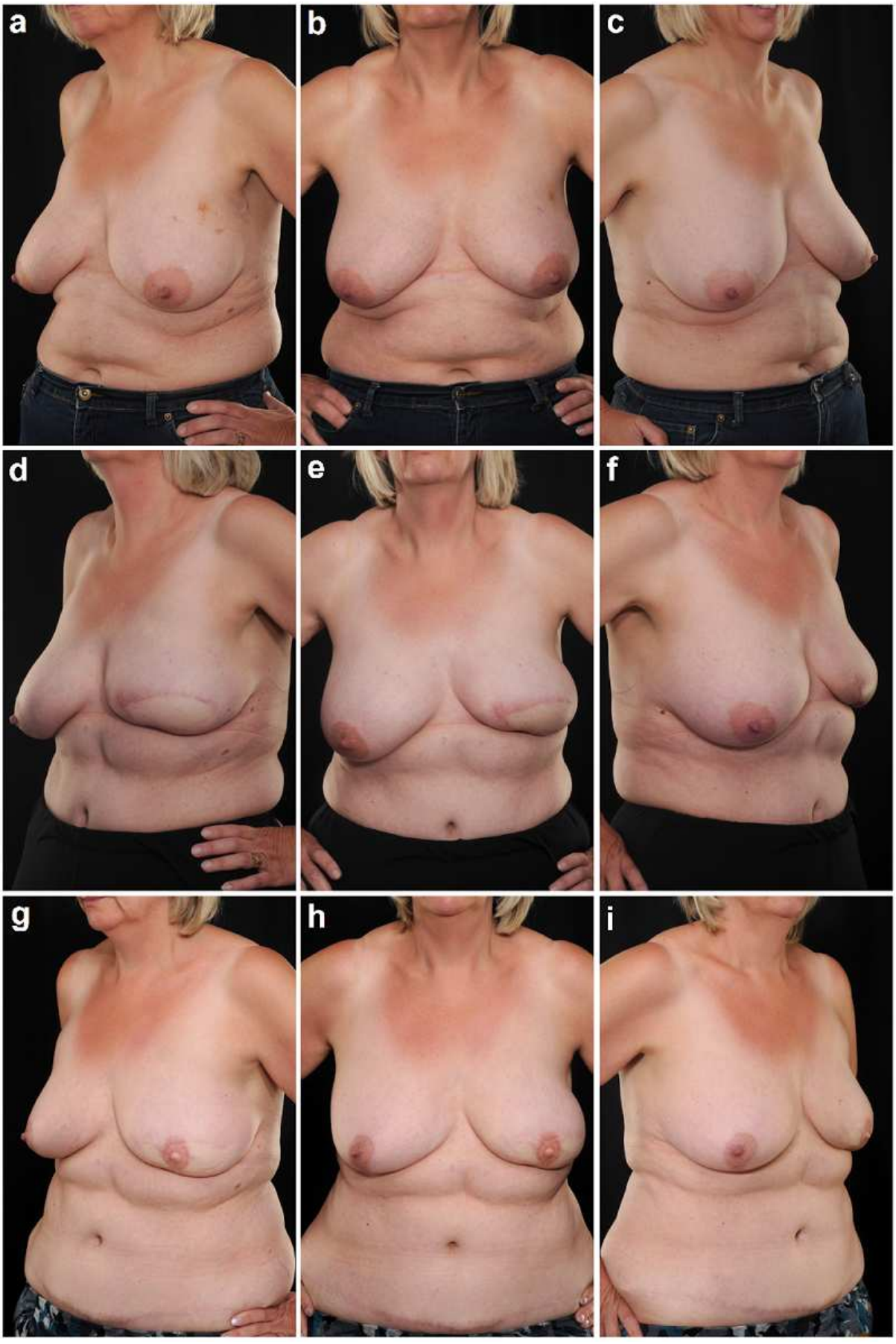
| Table 3. Outcomes for Women Undergoing Unilateral DIEP flap Breast Reconstruction | | Without Simultaneous Symmetrisation (N=216) | With Simultaneous Symmetrisation (N=155) | p-value | OR | 95% CI |
|---|---|---|---|---|---|---|
| Any post-operative complication requiring re-operation (%) | | 28 (13.0) | 14 (9.03) | 0.251 | 0.67 | 0.34, 1.31 |
| Peri-operative complications requiring re-operation (%) | Haematoma of the DIEP flap | 7 (3.23) | 6 (3.87) | 0.718 | 1.20 | 0.39, 3.63 |
| | Haematoma of the abdominal donor site | 0 (0) | 2 (1.29) | 0.512 | - | - |
| | Infected seroma of symmetrized breast | 2 (0.93) | 0 (0) | 0.512 | - | - |
| | Debridement of umbilical stalk necrosis | 2 (0.93) | 0 (0) | 0.512 | - | - |
| | Debridement of mastectomy skin envelope necrosis and skin grafting | 2 (0.93) | 0 (0) | 0.512 | - | - |
| | Venous congestion of the DIEP flap | 7 (3.23) | 4 (2.58) | 0.768 | 0.79 | 0.23, 2.75 |
| | Ischaemia of the DIEP flap | 4 (1.85) | 2 (1.29) | 1.000 | 0.69 | 0.13, 3.83 |
| | Partial DIEP flap loss | 6 (2.78) | 5 (3.22) | 1.000 | 1.17 | 0.35, 3.89 |
| | Total DIEP flap loss | 1 (0.46) | 2 (1.29) | 0.574 | 2.81 | 0.253, 31.3 |
| Median Days in Hospital (IQR) | | 6 (1) | 6 (1) | 0.305 | - | - |

**Table 3.** Peri-operative outcomes for women undergoing DIEP flap breast reconstruction, grouped according to whether they had simultaneous symmetrisation or not (ie. for this analysis we have group women who were never symmetrized with those who were balanced at a secondary surgery as they are comparable at this stage).

| Table 4. Revision Surgery | | Immediate Symmetrisation (N=155) | Delayed Symmetrisation (N=22) | p-value | OR | 95% CI |
|---|---|---|---|---|---|---|
| Any Revision Surgery (%) | | 36 (23.2) | 12 (54.5) | 0.003 | 3.97 | 1.58, 9.94 |
| Cumulative Rate of Revision Breast Surgery (%) | | 30 (19.4) | 11 (50.0) | 0.003 | 4.17 | 1.65, 10.5 |
| Revision breast surgery (%) | Any lipomodelling | 15 (9.68) | 7 (31.8) | 0.007 | 4.57 | 1.59, 13.1 |
| | DIEP flap remodelling or advancement | 7 (4.51) | 1 (4.54) | 1.000 | 1.00 | 0.12, 9.00 |
| | Excision of fat necrosis | 2 (1.29) | 1 (4.54) | 0.330 | 3.64 | 0.32, 42.0 |
| | Any scar revision | 10 (6.45) | 2 (9.10) | 0.647 | 1.45 | 2.96, 7.10 |
| | Revision NAC reconstruction | 2 (1.29) | 0 (0) | 1.000 | - | - |
| | Revision native breast reduction or mastopexy | 6 (3.87) | 4 (18.2) | 0.023 | 5.52 | 1.42, 21.4 |
| Cumulative rate of revision abdominal surgery (%) | | 10 (6.45) | 9 (40.9) | <0.001 | 10.0 | 3.46, 29.1 |
| Revision abdominal surgery (%) | Debridement and delayed closure after infected dehiscence | 2 (1.29) | 0 (0) | 1.000 | - | - |
| | Repair of abdominal wall hernia or bulge | 2 (1.29) | 2 (9.10) | 0.076 | 7.65 | 1.02, 57.4 |
| | Scar revision | 6 (3.87) | 7 (31.8) | 0.002 | 7.92 | 2.37, 26.5 |

**Table 4.** Revision surgeries on the breast and abdomen for patients who underwent contralateral breast symmetrisation following unilateral DIEP flap breast reconstruction

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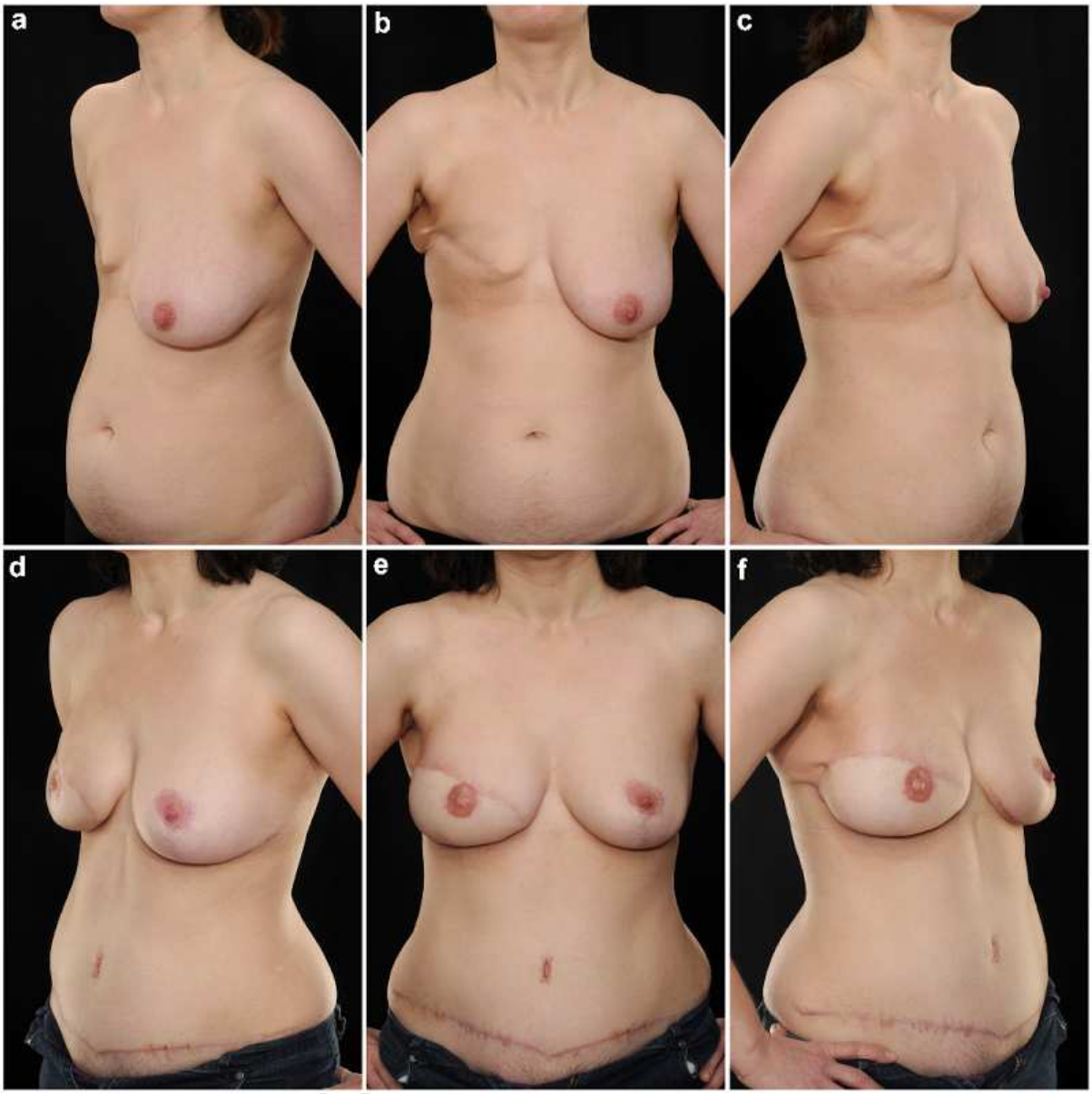

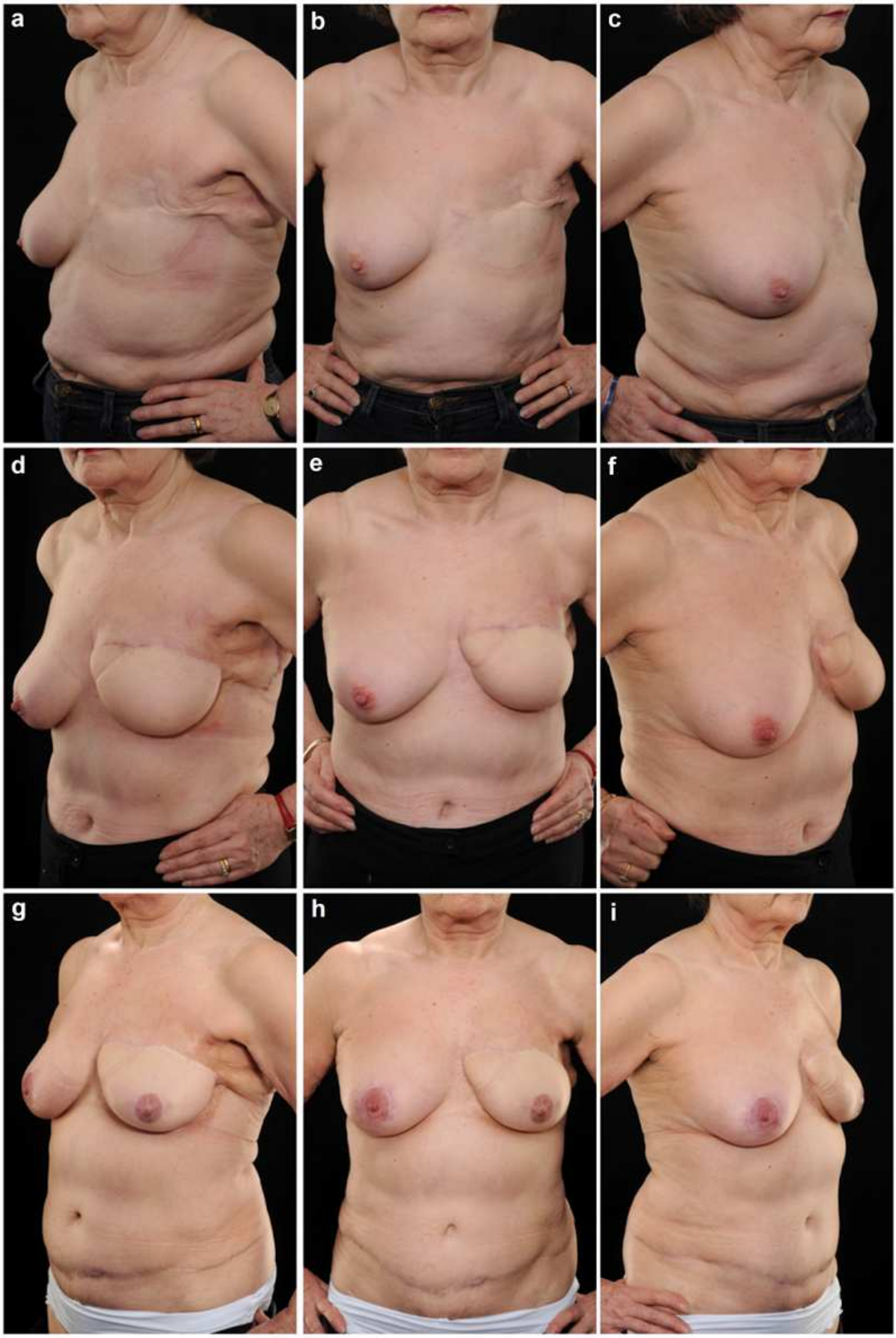
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