

# Initial experience with breast reconstruction using the transverse rectus abdominis myocutaneous flap: a study of 45 patients

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## SUMMARY

**Breast conserving surgery for breast cancer has led to an increased interest in reconstruction following mastectomy. The transverse rectus abdominis myocutaneous flap has been proven to give good results in terms of restoration of body symmetry with near normal contour and consistency. Furthermore, immediate reconstruction has the advantage of a single procedure with less psychological morbidity, and reduction in hospital stay and overall complication rate. The aim of this study was to review our experience with the transverse rectus abdominis myocutaneous flap procedure an initial series of 45 patients. The overall complication rate of 27% is similar to that reported in the literature, with no total flap loss and nine patients with partial flap loss. There was no delay in commencement of adjuvant chemotherapy or radiotherapy and we believe our ability to detect local recurrence has not been compromised. We consider that immediate breast reconstruction is now an integral part of the surgical treatment of breast cancer.**

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## INTRODUCTION

The change in emphasis in breast cancer surgery towards breast conservation has, paradoxically, produced a greater awareness of the needs and benefits of breast reconstruction following mastectomy. So much so, that the concept, and provision (if required), of breast reconstruction following mastectomy is now an established component of breast cancer management.<sup>1</sup> The goals of reconstruction are both functional and aesthetic, aiming to restore body symmetry and to achieve as near normal breast contour and consistency as possible. This should be achieved without compromising immediate or subsequent treatment of cancer.

Reconstruction may be performed at the time of the initial surgery for cancer (immediate) or at a later date (delayed). Immediate reconstruction has advantages over delayed reconstruction.<sup>2,3,4</sup> These include a lower incidence of postoperative psychological morbidity with less disruptions of body image,<sup>5,6,7</sup> and the avoidance of a secondary procedure with reduction in total hospitalisation and overall complication rate. This can be achieved without compromise of the aesthetic

result or subsequent adjuvant therapy for the treatment of the cancer.<sup>8,9</sup> Many reconstructive procedures using autologous tissue, prosthetic materials or a combination of both, have been described.<sup>10,11,12</sup> However, whilst it is a major procedure, the transverse rectus abdominis myocutaneous (TRAM) flap is now recognised as the "gold standard" reconstructive procedure. Many large series from specialty units have demonstrated the efficacy and relative safety of the TRAM flap.<sup>13,14,15</sup> The purpose of this study was to assess our experience with the TRAM procedure in a specialist Breast Unit and to compare our results with those of the major published series.

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## MATERIALS AND METHODS

The case notes of patients who had undergone the TRAM procedure between December 1993 and May 1998 were reviewed. In addition to demographic data, details of the operative procedure and post operative follow up were recorded. Complications were categorised as (1) general, (2) flap associated or (3) abdominal.

Flap-related complications were classified as total or partial flap loss. Partial flap loss was defined as any amount of skin loss, with or without subcutaneous tissue loss (fat necrosis). Fat necrosis was identified early in the post operative period clinically. Late fat necrosis (occurring after 30 days) was confirmed by clinical and cytological assessment. The abdominal wound was examined for infection, hernia formation and abdominal laxity.

### Patient Selection

Following diagnosis of breast carcinoma, patients were selected for reconstruction after consultation by the Consultant Surgeon and Specialist Breast Care Nurse. The major criterion in determining suitability was requirement for mastectomy. Other criteria used to determine suitability included age (< 60 years), body habitus (Body Mass Index < 30), smoking status (non-smoking desirable) and patient motivation. Previous abdominal surgery did not exclude reconstruction. Patients with stage IV disease were deemed unsuitable.

### Surgical Technique

On the day prior to surgery markings are made to identify the area of skin to be excised at mastectomy and to assess the dimensions of the flap. In immediate reconstruction, initially a mastectomy is performed, in combination with axillary node clearance as indicated. The surgical team then rescrubs and the patient is redraped prior to mobilisation of the abdominal flap.

This next phase of the operation involves mobilisation of the rectus abdominis muscle together with a lower abdominal subumbilical transverse island of overlying fat and skin. Following dissection of the skin island down to the fascia of the anterior abdominal wall, the lateral parts of the flap are dissected free extending medially to the borders of the rectus abdominis muscles. The entire width of the rectus abdominis muscle which is to carry the flap (usually the contralateral muscle) is dissected from its fascial sheath. The inferior epigastric vessels are divided

at their origin and protected to allow for supercharging-of the pedicle if required. The abdominal skin with the subcutaneous fat above the flap is dissected from the abdominal wall fascia and mobilised at least to the inferior costal margin. An appropriately sized, oblique, subcutaneous tunnel is created between the mobilised abdominal skin and the mastectomy wound.

If necessary the lateral ends of the skin and fat islands are excised and discarded as dictated by the segmental vascular division of the flap. The flap pedicle, with the rectus abdominis muscle still attached to its origin, is then delivered into the mastectomy wound defect via the fascial tunnel, to lie in the transverse plane. The in-situ flap is now shaped, sized and contoured on the chest wall, the aim being to match the other breast, build the axillary fold, infraclavicular groove, and the inferior bulk of the breast. This is achieved by trimming and sculpting of fat in combination with de-epithelisation.

The rectus fascia is approximated with interrupted non-absorbable sutures and if required a polypropylene mesh is used to realign the abdominal wall and reduce tension. The umbilicus is reimplanted, the wounds are drained and closed in two layers. Following surgery patients are nursed semi-recumbent with their knees flexed but are mobilised on the fourth post-operative day.

### Follow up

Patients were reviewed in the Breast Clinic at one month, then at intervals of three months for the first year, four months for two years and six monthly for five years. The TRAM flap was assessed for flap complications, cosmesis and evidence of local recurrence. Mammography was performed at yearly intervals.

## RESULTS

In the study period 45 patients have undergone TRAM procedure in this unit. In 37 patients immediate reconstruction was undertaken concurrently with mastectomy and axillary clearance. The average age at operation was 44 years (range 26 to 57). Length of stay ranged from 6 to 26 days (mean 9). The duration of operation (varying from 3 hours 45 minutes to 7 hours depending on the procedures performed), averaged 5 hours 30 minutes. Eleven patients underwent simultaneous contralateral reduction

mammoplasty; average operating time in this group was six hours.

Forty-four patients remain under regular review. One patient has died as a result of disseminated carcinoma. Systemic disease, relapse or loco-regional recurrence has not been identified in any of the remaining 44 patients. Tumour pathology is as shown (Table I).

TABLE I

<i>Histological diagnoses in patients who underwent TRAM procedure</i>	
Invasive ductal carcinoma	34
Invasive lobular carcinoma	6
Ductal carcinoma in situ (DCIS)	2
Invasive mixed ductal/lobular	1
Mucinous carcinoma	1
Tubular carcinoma & DCIS	1

Nine patients developed varying degrees of partial flap loss. In three of these patients the loss was confined to skin only. The extent varied from 5% to 30% of the total TRAM area, 14% on average. The skin necrosis was noted to be exclusively on the medial aspect in six cases. One patient had necrosis also on the lateral aspect. Six of these nine patients were smokers and two had had previous radiotherapy. Following skin healing four of these developed focal modularity due to underlying fat necrosis. Four patients early in the series, and one more recently, required a second wound toilet procedure (all performed under local anaesthetic) for excision of skin and tissue necrosis; one patient required two procedures. One required refashioning of the flap five months after the initial procedure.

Fat necrosis (late) occurred in the TRAM flap in only two cases independent of skin necrosis. This was minor in both cases and required no further treatment once the diagnosis was confirmed. In one case fat necrosis developed following a wound infection. We have not experienced any total flap loss to date.

There were no cardiopulmonary complications in the series. Two patients developed confirmed uncomplicated urinary tract infections early in the post-operative period. There was one wound infection which involved the abdominal wound.

There have been no abdominal herniae reported by the patients or detected at review on clinical examination. One patient suffered a minor granuloma of the umbilicus which resolved with application of silver nitrate. One patient has required a minor revision (excision of dog ears) of the abdominal scar. Two patients complained of abdominal tightness early in the postoperative period but this settled spontaneously.

There were no reported complications with the reduced breast in the eleven patients who underwent contralateral mammoplasty. No augmentations were required on the reconstructed side, and none of the contralateral reductions or mammoplasties have needed augmentation or revision.

TABLE II

<i>Flap-specific complications following TRAM procedure</i>	
Total flap necrosis	0
Partial flap necrosis: skin necrosis only	3
skin and fat necrosis	6
Wound infection	1
Late fat necrosis	2
<b>Total</b>	<b>12/45 (27%)</b>

Additional non-surgical treatment was administered in 39 patients post-operatively. Tamoxifen only was given to 16 patients, tamoxifen combined with chemotherapy in 14 cases and chemotherapy only in five patients. Two patients were given electron therapy to the skin flaps above the TRAM followed by chemotherapy. Two patients had a combination of electron therapy, chemotherapy and tamoxifen. Reconstruction has not led to a delay in commencement of treatment of any patient.

At follow-up (median 29 months (range 1 - 51 months)) 42 patients have had a satisfactory cosmetic result with good symmetry. Two patients have TRAM flaps which are approximately 30% smaller than the contralateral breast. In one patient this was due to flap loss. One patient gained 15 kg, the gain to the TRAM flap being disproportionate to the other breast. This patient required reduction of the TRAM flap.

These results are similar to other published series (Table III).

TABLE III

*Comparison of present study with published series*

	<i>Rosen et al</i> <sup>15</sup>	<i>Elliott et al</i> <sup>13</sup>	<i>Wilkins et al</i> <sup>8</sup>	<i>Andrews et al</i>
Total patients	41	128	53	45
Type of TRAM flap				
Immediate	41	128	73	38
Delayed	0	0	0	7
Pedicled	41	86	46	38
Free	0	40	27	0
Average age (years)	46	47	46	44
Days in hospital	N/A	6.5	6.6	9
Operative time (hours)	4	4.8	7.6	5.5
Total flap loss (%)	0	2	0	0
Total flap complication rate (%)	24	28	29	27

**DISCUSSION**

As the benefits of breast reconstruction at the time of or at a later date following mastectomy have become more widely known by the general public, the demand for reconstruction from women undergoing mastectomy has increased.<sup>16</sup> Recent public debate concerning problems with the use of silicone implants<sup>17,18,19</sup> has led to greater emphasis on reconstructive procedures which use autologous tissue.<sup>12,20</sup> If patients are suitable, the TRAM flap offers the best reconstructive results in terms of breast shape, size and consistency.<sup>14,17</sup> In addition, if it is performed at the time of mastectomy, it has the advantages of a single procedure, decreased hospitalisation, and comparable cosmetic results to delayed reconstruction.<sup>21</sup>

In our series the flap-related complication rate of 27% compares favourably to that of other authors. The nine cases of partial flap loss have had a satisfactory outcome in all but one patient. This patient required further surgery on the TRAM flap and as a result the overall cosmetic appearance was suboptimal. Seven of these patients were early in the series and such early problems have been described by other groups.<sup>8,20</sup> Furthermore, six of these patients were smokers and two had had previous radiotherapy. We would now regard smoking as a relative contraindication and of more significance than age or BMI as indirect prognostic variables.

Our total complication rate of 36% is equivalent to that of other series of TRAM reconstruction.<sup>16</sup> It is also well below the complication rate reported for mastectomy alone.<sup>3</sup>

Our hospitalisation time is slightly longer than in other groups. A number of factors are involved in this. One patient stayed 26 days. Of the nine whose stay was 12 days or longer, seven were those who developed areas of skin necrosis and required in-hospital treatment for this. We would now manage these patients on an outpatient basis thus reducing length of stay.

Our average operating time is 5 hours 30 minutes which is longer than that of other published series.<sup>13,15,22</sup> However, in these series the surgical oncologist, performing the mastectomy, and the reconstructive surgeon, commencing the flap procedure, work in tandem at the beginning of the operation thereby reducing the operating time. Both our procedures are performed by a single surgical team.

There is no evidence that the risks to patients undergoing the combined procedure of TRAM flap and contralateral mammoplasty are higher than those of the two procedures performed separately,<sup>23</sup> this is confirmed by our figures.

Our low rate of abdominal wound complications is equivalent to that experienced elsewhere. The use of mesh repair, as is our practice, is known to reduce the rate of abdominal hernia formation.<sup>24</sup>

Tightening of the abdominal girth post-operatively is a secondary benefit with which most patients are content.

Local treatment and adjuvant therapy are not compromised by immediate reconstruction. No patients had their adjunctive therapy delayed or altered as a consequence of undergoing the TRAM procedure. Electron therapy (to non-flap skin) has not affected the flap outcome. With a mean follow-up of 29 months there have been no incidences of loco-regional recurrence. This low rate is in keeping with other series.<sup>25</sup> We do not feel that reconstruction has compromised our ability to detect loco-regional recurrence.

The findings of our study demonstrate that immediate breast reconstruction does not compromise patient treatment or outcome. Although the numbers are small there does not appear to be any difference in outcome between immediate and delayed reconstruction. The technique is well tolerated by the patient.

In conclusion, our initial experience with TRAM flap reconstruction has demonstrated that we can produce an aesthetic, effective and safe means of breast reconstruction with a complication rate equivalent to that of the other major published series, without compromising the treatment of breast cancer. We therefore feel that immediate reconstruction should be considered an integral part of the surgical treatment of breast cancer.

#### REFERENCES

- Bostwick J, Vasconez L O, Jurkiewicz M J. Breast reconstruction after a radical mastectomy. *Plast Reconstr Surg* 1978; **61**: 682-93.
- Noone R B, Murphy J B, Spear S L, Little J W. A 6-year experience with immediate reconstruction after mastectomy for cancer. *Plast Reconstr Surg* 1985; **76**: 258-69.
- Vinton A L, Traverso L W, Zeuring R D. Immediate breast reconstruction following mastectomy is as safe as mastectomy alone. *Arch Surg* 1990; **125**: 1303-8.
- Johnson C H, van Heerden J A, Donohue J H et al. Oncological aspects of immediate breast reconstruction following mastectomy for malignancy. *Arch Surg* 1989; **124**: 819-824.
- Stevens L A, McGrath M H, Druss R G, Kister S J, Gump F E, Forde K A. The psychological impact of immediate breast reconstruction for women with early breast cancer. *Plast Reconstr Surg* 1984; **73**: 619-28.
- Schain W S, Weillisch D K, Pasnau M D, Landsverk J. The sooner the better: a study of psychological factors in women undergoing immediate versus delayed breast reconstruction. *Am J Psychiat* 1985; **142**: 40-6.
- Dean C, Chetty U, Forrest A P M. Effects of immediate breast reconstruction on psychosocial morbidity after mastectomy. *Lancet* 1983; **1**: 459-62.
- Wilkins, E G, August D A, Kuzon W M, Chang A E and Smith D J. Immediate transverse rectus abdominis musculocutaneous flap reconstruction after mastectomy. *J Am Coll Surg* 1995; **180**: 177-83.
- Mansel R E, Horgan K, Webster D J et al. Cosmetic results of immediate breast reconstruction post-mastectomy: a follow-up study. *Br J Surg* 1986; **73**: 813-6.
- Schneider W J, Hill H L, Brown R G. Latissimus dorsi myocutaneous flap for breast reconstruction. *Br J Plast Surg* 1977; **30**: 277-81.
- Drever J M. Total breast reconstruction. *Ann Plast Surg* 1981; **7**: 54-61.
- Bostwick J, Carlson G W. Reconstruction of the breast. *Surg Oncol Clin N Am* 1997; **6**: 71-89.
- Elliott L F, Eskenazi L, Beegle P H et al. Immediate TRAM flap breast reconstruction: 128 consecutive cases. *Plast Reconstr Surg* 1993; **92**: 217-27.
- Hartrampf, C R. The transverse abdominal island flap for breast reconstruction: a 7-year experience. *Clin Plast Surg* 1988; **15**: 703-16.
- Rosen P B, Jabs A D, Kister S J, Hugo, N E. Clinical experience with immediate breast reconstruction using tissue expansion or transverse rectus abdominis musculocutaneous flaps. *Ann Plast Surg* 1990; **25**: 249-57.
- Crespo L D, Eberlein T J, O'Connor N, Hergueter C A, Pribaz J J, Eriksson Postmastectomy complications in breast reconstruction. *Ann Plast Surg* 1994; **32**: 452-6.
- Melmed E P. Silicone implants: aesthetic triumph or surgical disaster? *Plast Reconstr Surg* 1996; **98**: 1071-3.
- Noone R B. A review of the possible health implications of silicone breast implants. *Cancer* 1997; **79**: 1747-56.
- FDA requests moratorium on silicone breast implants. FDA Medical Alert 1992; MDA92- 1.
- Hartrampf C R, Bennett G K. Autogenous tissue reconstruction in the mastectomy patient, a critical review of 300 patients. *Ann Surg* 1987; **205**: 508-19.
- Kroll S S. Immediate breast reconstruction. a review. *Ann Chir Gynaecol* 1997; **86**: 5-12.
- Bunkis J, Walton R L, Mathes S J, Krizek T J, Vasconez L O. Experience with the transverse lower rectus abdominis operation for breast reconstruction. *Plast Reconstr Surg* 1983; **72**: 819-27.
- Stevenson T R, Goldstein J A. TRAM flap breast reconstruction and contralateral reduction or mastopexy. *Plast Reconstr Surg* 1993; **92**: 228-33.
- Kroll S S, Marchi M. Comparison of strategies for preventing abdominal-wall weakness after TRAM flap breast reconstruction. *Plast Reconstr Surg* 1992; **89**: 1045-51.
- Eberlein T J, Crespo L D, Smith B L, Hergueter C A, Douville L, Eriksson E. Prospective evaluation of immediate reconstruction after mastectomy. *Ann Surg* 1993; **218**: 29-36.