

Subpectoral breast reconstruction using the biodimensional system

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Increasing awareness among the general public has fuelled a demand for post-mastectomy breast reconstruction. However, owing to the limited number of plastic surgical centres this need is unlikely to be fulfilled in the near future.

We report our early experience with a modified technique using a new subpectoral implant—the Biodimensional System. Seventeen consecutive patients underwent reconstruction (16 immediately) after mastectomy. In the group of patients having immediate reconstruction, the surgery was undertaken by the breast surgeon performing the primary procedure. This study demonstrates that an acceptable result can be obtained in the majority of patients and that it is possible for a breast surgeon to undertake primary reconstruction on selected patients using the Biodimensional System.

It is hoped that this may aid patients in their physical and mental rehabilitation.

The number of mastectomies performed for breast carcinoma has fallen dramatically since the acceptance of breast-conserving surgery and radiotherapy (1) and, more recently, primary chemotherapy. However, mastectomy remains the only surgical option for some patients. Current indications for a mastectomy include locally advanced disease, centrally sited tumours, widespread ductal carcinoma *in situ*, local recurrence and, of course, patient preference.

The well-documented psychological morbidity asso-

ciated with breast cancer has been partly attributed to the loss of body image after mastectomy (2,3). This may be lessened by reconstruction. Breast reconstruction can either be performed at the time of the initial mastectomy (immediate reconstruction) or as a separate procedure after the completion of systemic treatment and healing (delayed reconstruction).

We describe our initial experience with the new Biodimensional System—a saline tissue expander and a silicone-filled prosthesis. This design differs from previously used systems such as the Becker prosthesis (4) in that the saline expander is replaced with a silicone-filled implant at a second procedure, whereas in the Becker system the expander doubles as a permanent saline-filled prosthesis (4). Unlike the Becker system, the filling port lies within the saline expander, and not in the subcutaneous position, which can be uncomfortable. The permanent prosthesis is novel in that it is designed to adopt the shape of the natural breast rather than a symmetrical dome and so give a more natural appearance to the reconstruction (Fig. 1). Although this new system of subpectoral breast reconstruction has been reported in the North American literature, this is the first reported series from the United Kingdom. We draw attention to important points concerning patient selection and operative details, and conclude that this relatively simple method of reconstruction may be applicable as a reconstructive technique for use by general surgeons with a specialist interest in breast cancer.

Patients and methods

Patients

A series of 17 consecutive patients, average age of 50 years, underwent breast reconstruction using the Biodimensional System between June 1994 and March 1995.

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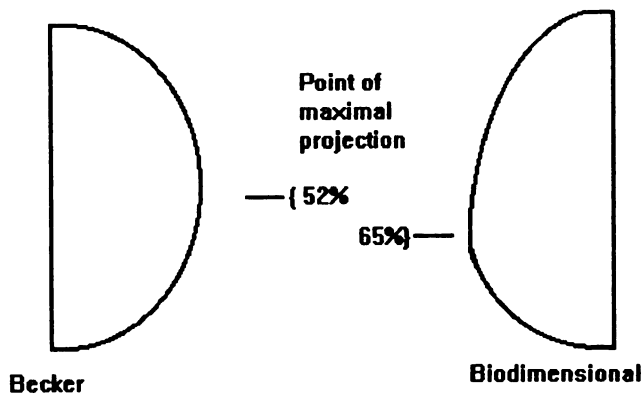


Figure 1. Diagram showing the lateral profile of the Biodimensional *versus* the Becker prosthesis in the vertical position. Note the point of maximal projection is nearer to the pole (65% of the vertical axis *vs* 52%) thus giving a more natural appearance to the prosthesis (12).

Of these patients, 16 had an immediate breast reconstruction and one a delayed procedure after a mastectomy elsewhere. The indications for surgery and the operations performed are listed in Table I. The patients were fully counselled as to the possible options, ie no reconstruction, a myocutaneous flap reconstruction, or the subpectoral Biodimensional System. All the patients included in this series were clinically thought to be ideal candidates for subpectoral reconstruction.

All patients were offered, but declined, nipple reconstruction.

Operations and prostheses

The patients underwent surgery in a single breast cancer unit staffed by general surgeons with an interest in breast surgery. The Biodimensional System was used (McGhan Medical Corporation, 700 Ward Drive, Santa Barbara California CA9311-2936). This system involves the use of a uniquely shaped saline tissue expander and a similarly shaped definitive silicone-filled prosthesis. The tissue expander is anatomically shaped with an injection port on the anterior surface. A metal marker allows identification

of the port by a hand-held magnetic locator in order that its exact position can be identified for inflation. This expander is removed at a second operation and is replaced by the permanent anatomically shaped silicone-filled prosthesis. This prosthesis differs from traditional designs in that it is asymmetric, allowing greater projection in the lower compared to the upper pole. This is thought to give the breast mound a more realistic shape in profile (Fig. 1). It has a textured surface which has been demonstrated to decrease the incidence of capsular contracture (5,6).

The size of the tissue expander is selected preoperatively by use of circular templates which identify the size of the breast disc on the chest wall. The level of the inframammary fold is marked before the operation. After the mastectomy, a pocket between pectoralis major and the underlying origins of pectoralis minor and serratus anterior is developed by careful dissection. A low muscle cutting approach to the pocket is made by opening the inferior limit of pectoralis major at the level of the inframammary fold. It is also possible to use a muscle-splitting approach, dividing pectoralis major in the line of its fibres at any level. However, this may compromise adequate dissection at the inferior limit of the pocket. The pocket is developed further by careful dissection to the limits of pectoralis major—medially to the sternal insertion, superiorly to the second intercostal space and laterally to its border (Fig. 2). It is important to maintain the integrity of the pocket, in particular laterally, as this prevents drift of the expander. The use of malleable retractors facilitates dissection and allows for meticulous haemostasis at the uppermost aspect of the pocket. After insertion of the expander, which is orientated by ensuring that the injection port is anterosuperior, the deficit in pectoralis major is closed with Vicryl® over a suction drain. After skin closure the prosthesis is secured laterally and superiorly by externally applied tapes and then inflated with 100 ml of saline. All the operations were performed with intravenous antibiotic prophylaxis (three doses of cefuroxime 750 mg and metronidazole 500 mg).

Table I. Indications for surgery and oncological operations. A modified radical mastectomy involved a level 2 axillary dissection with preservation of the insertion of pectoralis minor

Indication	Number of patients	Operation
Primary carcinoma	9	Modified radical mastectomy
Bilateral carcinoma	1	Bilateral simple mastectomy
Widespread DCIS	3	Simple mastectomy
Widespread recurrence	2	Simple mastectomy
Prophylaxis for family history	2	Bilateral simple mastectomy

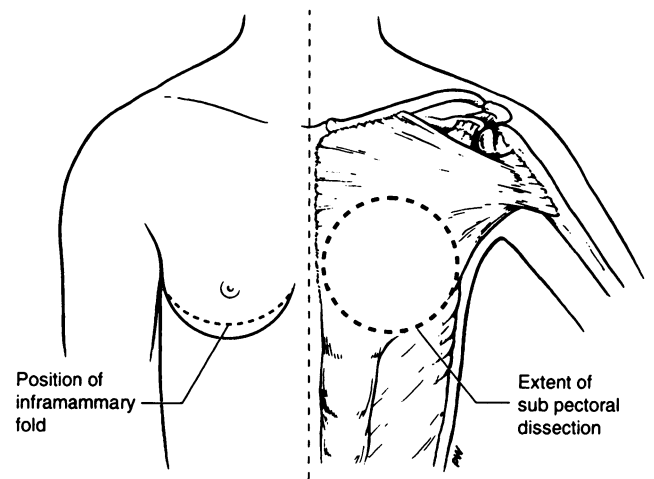


Figure 2. Illustration showing the extent of the subpectoral dissection. Note that the dissection extends to below the level of the opposite inframammary fold.

The patients wore firm external corsets in the first 2 weeks postoperatively, as this is the period when the prosthesis is at most risk of migration, either laterally or superiorly.

Expansions

This process is started at 4 to 8 weeks after the initial procedure. The procedure is performed under sterile conditions in the outpatient department at approximately monthly intervals with 100 ml of saline being inserted on each attendance. The port is identified by the magnetic locator and saline injected into this with a butterfly needle (Fig. 3). The inflation is continued until the prosthesis is overinflated by 100 ml relative to the contralateral breast. Ideally, the expander is maintained *in situ* at its final volume for 6 weeks.

Replacement with the permanent prosthesis

The expander is exchanged for the definitive final prosthesis under general anaesthesia. A 5 cm incision at the lateral aspect of the primary scar is made and the underlying muscle divided. The presence of an inflammatory capsule facilitates the removal of the prosthesis and the resulting pocket is, by this stage, clearly defined and resilient. The volume in the expander is measured, and this should correspond exactly to the inflation record. The size of the permanent prosthesis is selected to be 100 ml less than the volume of the expander. The final result is checked before insertion by the use of sterile sizers placed into the pocket, with the patient raised to 60° to compare the appearance with the contralateral breast.

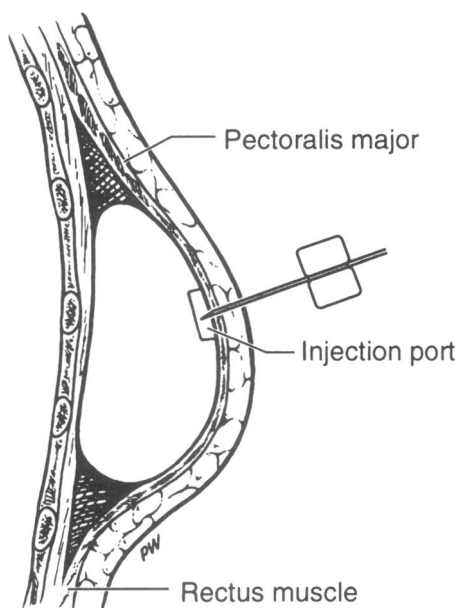


Figure 3. Position of the expander in the subpectoral pocket. The injection port lies in the expander as shown and is located by a simple magnetic device. Saline is injected via a butterfly needle.

The wound is closed over a small suction drain which is removed the next morning.

Assessment of results

Assessment was by means of a patient questionnaire and an independent assessment of standardised photographs (anterior and lateral views). These were taken 3 months after the final operation. The questionnaire asked about the shape, symmetry and appearance of the prosthesis in various states of clothing, and also enquired about the patient's attitude to wearing certain styles of clothes (eg swimming costumes), body image and self-confidence. The patients were asked to score each question from terrible (1) to excellent (5).

The independent photographic assessment was undertaken by a male consultant general surgeon with an interest in breast surgery and a female breast care nurse, both from different institutions. Photographs were taken with the patient unclothed and wearing a bra. One patient refused to be photographed.

Results

The time for each operative procedure was compared with similar operations without reconstruction performed by the same surgeon and on average an extra 40 min of operative time was spent inserting the expander.

The average number of attendances for inflations was three and the average interval between operation and final insertion was 21 weeks (range 12–32 weeks).

	Mean time (range) min	Mean inpatient stay (range) days
Primary operation	90 (120–170)	5 (4–8)*
Insertion of definitive prosthesis	22 (16–25)	1

* The mean inpatient stay was no different when compared with patients who did not have a reconstruction after mastectomy

Complications

One patient had a wound infection requiring treatment with antibiotics, and another had a partial wound dehiscence requiring re-suturing. Both of these patients had an uneventful subsequent exchange of expander for the definitive prosthesis. Two expanders were inadvertently punctured by doctors who were trying to drain suspected 'seromas' necessitating their removal.

Each patient has now been followed up for over 12 months. No patient has required surgery for capsular contracture.

Assessment by questionnaire and independent photographs

The results of the patients' own assessment of their appearance, and the opinion of the two independent

assessors are shown in Table II. Of the patients, 77% assessed their appearance in a bra, in terms of shape and symmetry as good or excellent. When they were assessed in a bra by the two independent assessors, the appearance

Table II. Results of 15 breast reconstructions as assessed by patient questionnaire and independent photographic assessment. The patients and two independent assessors (a consultant surgeon and a breast care nurse) were asked to score the reconstruction for shape and symmetry from 1–5 (1 = terrible, 2 = poor, 3 = fair, 4 = good, 5 = excellent). The results are expressed as percentages for scores of 4 and 5, ie good or excellent results

	<i>Good or excellent results</i>		
	<i>With blouse</i>	<i>With Bra</i>	<i>Unclothed</i>
<i>Patient Self-assessment</i>			
Shape	80%	77%	60%
Symmetry	86%	77%	46%
<i>Independent assessor 1</i>			
Shape	—	62%	29%
Symmetry	—	62%	29%
<i>Independent assessor 2</i>			
Shape	—	50%	29%
Symmetry	—	58%	29%

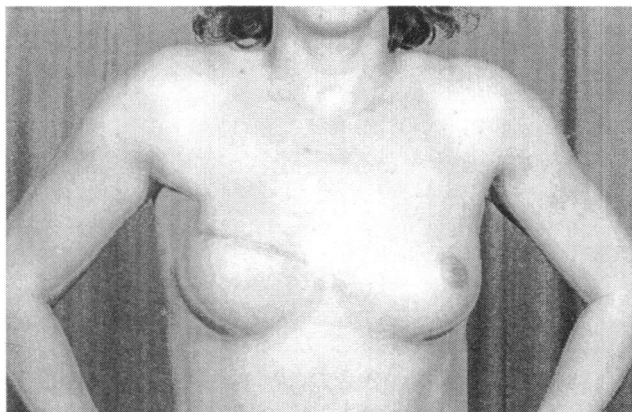


Figure 4a. Unilateral reconstruction

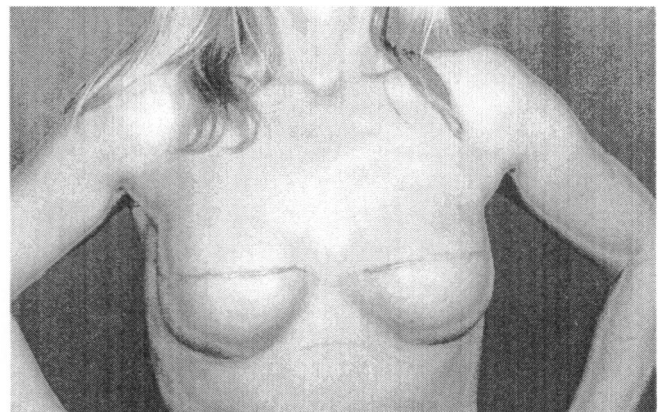


Figure 4b. Bilateral reconstruction

Figure 4. Two examples of subpectoral reconstructions, unilateral and bilateral. The photographs were taken at 3 months after insertion of the final prosthesis and show rather immature scars.

was rated as good or excellent in 62% and 55% of cases. Unclothed (Fig. 4), more than half of the patients thought the result good or excellent compared with the independent assessors' verdict, in which less than one-third of the patients achieved the top grades. When asked in more subjective terms about their breast reconstruction, every patient felt they would wear a swimsuit, and of the patients who had worn either a bikini or a low cut dress before their operation, 80% said they would continue to do so.

Of the patients, 86% found the reconstructed breast comfortable, rating this aspect as good or excellent. Only two patients commented on the intermittent expansion as being either uncomfortable or painful, but none of the patients objected to attending outpatients for expansion. All patients felt that they could recommend the reconstruction to a friend undergoing a mastectomy.

Discussion

It is established that the combination of local excision and radiotherapy offers equivalent survival rates to mastectomy for breast cancer (1). Consequently, breast-conserving surgery is used routinely, with the aim of minimising the psychological morbidity of surgery, while

not compromising cure (7). Mastectomy and immediate breast reconstruction is not intended as an alternative to breast-conserving surgery, but rather is intended to ameliorate the physical and psychological consequences of surgery in those patients in whom mastectomy cannot be avoided.

Breast reconstruction is not available routinely to women undergoing mastectomy either as an immediate or as a delayed procedure. This is because breast reconstruction is traditionally by means of a myocutaneous flap, either the ipsilateral latissimus dorsi muscle with an implant (8) or the contralateral transverse rectus abdominis muscle (TRAM). Although myocutaneous flap reconstruction has been taken up by some specialist breast surgeons (9), this surgery usually requires the surgeon to have experience in reconstruction and is usually only performed by plastic surgeons and not by the primary surgeon. Therefore, reconstruction is either performed as a joint procedure, which is not feasible in most centres, or delayed until it can be performed in a regional plastic surgery unit. Although the cosmetic results can be excellent, the surgery is major and recovery can be protracted. The complications include flap necrosis, a significant donor site scar and a risk of an incisional hernia after TRAM flap reconstruction (10,11).

The placement of an implant in the plane between pectoralis major and the pectoralis minor is simple and less time consuming (12), but it does require care in the accurate delineation of the extent of the pocket. The overlying tension of the pectoral muscles can flatten a prosthesis into an unnatural shape and so the insertion of subpectoral breast implants without prior tissue expansion can often lead to an unsatisfactory result unless the contralateral breast is very small. It is also not possible to achieve any ptosis with this method. These problems have been addressed to some degree by the use of incremental expansion, which also circumvents the need to gain extra skin coverage from a donor site. Ptosis is achieved by overexpansion.

The most frequently used system in Britain is the Becker (4,12), where the expander and prosthesis have been incorporated into a double lumen device with an inner saline chamber enclosed in an outer silicone gel-filled chamber. The inner saline chamber is filled via a port. This port is positioned away from the subpectoral pocket in the mid axillary line and is removed, under local anaesthesia, after the final volume is achieved.

This Biodimensional System uses a two-stage procedure in which the saline expander is replaced with a silicone-filled prosthesis. The expander and prosthesis are designed to adopt the contour of a natural breast with a deeper, wider lower pole (13) (Fig. 1), and not a simple symmetrical circular dome. This system requires a second general anaesthetic for the exchange, but the post-operative hospital stay is usually only overnight.

In this series, half of the patients commented on the relative asymmetry of the reconstructed breast compared with the contralateral breast. This was the most common problem identified by both the patients and assessors, even though it could be corrected with a bra. Failure to

achieve an adequate ptosis contributed to this and so it was most pronounced in patients with a ptotic contralateral breast and least obvious in the patients who underwent bilateral reconstructions.

We would like to draw attention to three points which are particularly relevant in this type of reconstruction.

1 Patient selection

It can be difficult to achieve symmetry in patients who have pendulous or large breasts and these patients may be more suited to a flap reconstruction, eg a TRAM flap together with a contralateral reduction mammoplasty. Conversely, this procedure is well suited to bilateral reconstructions (eg as prophylaxis in patients with a very strong family history of breast carcinoma), where the symmetry is excellent.

2 Operative technique

The most important operative detail is the development, by careful dissection, of the inferior aspect of the subpectoral pocket to 1 cm below the level of the contralateral inframammary fold. Ideally, this dissection should extend to the level of the lowest point of the opposite breast as measured with the patient seated (Fig. 2). We maintained complete muscle coverage as described in Maxwell's technique (14) for immediate reconstruction, although in delayed reconstruction it is possible to leave the most inferior pole of the prosthesis subcutaneously by detaching the inferior aspect of pectoralis major at its origin. The tendency of the prosthesis to drift superiorly or laterally can be minimised by taping the superior and lateral margins of the subpectoral pocket for 7 days postoperatively.

3 Patient expectations

All our patients underwent preoperative counselling by our breast care sister and had the opportunity to see photographs of previous reconstructions. We feel it is important to impress upon patients that the aim of the operation is to produce a breast reconstruction that gives the patient the self-confidence to wear clothing of their choice. It is of interest that in our patients, the results as assessed by the patients were consistently better than the assessment of the independent experts.

The complication rate in this series is high, but this is in part avoidable by better communication—two patients had their expanders punctured by doctors attempting to drain 'seromas' postoperatively. This has implications for the widespread introduction of any specialised technique.

As the public awareness of breast reconstruction increases, so will the demand for reconstructive procedures. In Britain the number of plastic surgeons per capita of population is low (eg as compared with the United States), and waiting lists for breast reconstruction in tertiary referral centres can be long. The technical simplicity of this procedure can make it a suitable reconstructive technique for general surgeons managing

breast cancer, but there is an associated learning curve and the best results will come with experience.

We do not advocate that this is suitable for all patients, nor do we think it can replace conventional reconstruction, but in a select cohort of patients it can provide an acceptable cosmetic result and so hopefully decrease the inevitable psychological and physical morbidity associated with oncological breast surgery.

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References

- 1 Early Breast Cancer Trialists Collaborative Group. Effects of radiotherapy and surgery in early breast cancer—an overview of the randomised trials. *N Engl J Med* 1995; **333**: 1444–55.
- 2 Morris T, Steven-Greer H, White P. Psychological adjustment mastectomy (a 2-year follow-up study). *Cancer* 1977; **40**: 2381–7.
- 3 Maguire GP, Lee EG, Bevington DJ *et al.* Psychiatric problems in the year after mastectomy. *Br Med J* 1978; **i**: 963–5.
- 4 Becker H. The expandable mammary implant. *Plast Reconstr Surg* 1987; **79**: 631–7.
- 5 Hakelius L, Ohlsen L. A clinical comparison of the tendency to capsular contracture between smooth and textured gel-filled silicone mammary implants. *Plast Reconstr Surg* 1992; **90**: 247–54.
- 6 Burkhardt BR, Demas CP. The effect of siltex texturing and povidone-iodine irrigation on capsular contracture around saline inflatable breast implants. *Plast Reconstr Surg* 1994; **93**: 123–8.
- 7 Schain WS, D'Angelo TM, Dunn ME, Lichter SA, Pierce LJ. Mastectomy versus conservative surgery and radiotherapy—psychosocial consequences. *Cancer* 1994; **73**: 1221–7.
- 8 Codner MA, Bostwick J, Nahai F. Breast reconstruction after mastectomy. *The Breast* 1995; **4**: 4–10.
- 9 Thomas JM. Latissimus dorsi reconstruction of the breast. *Br Med J* 1983; **287**: 569–70.
- 10 Abbes M, Huss M. Breast and chest wall reconstruction by latissimus dorsi myocutaneous flap (238 cases). *The Breast* 1995; **4**: 35–9.
- 11 Watterson PA, Bostwick J, Hester TR, Bried JT, Taylor GI. TRAM flap anatomy correlated with a ten year clinical exposure with 556 patients. *Plast Reconstr Surg* 1995; **95**: 1185–94.
- 12 Evans AA, Straker VF, Rainsbury RM. Breast reconstruction in a district general hospital. *J R Soc Med* 1993; **86**: 630–33.
- 13 Hammond DC, Perry LC, Maxwell GP, Fisher J. Morphological analysis of a tissue expander shape using a biomechanical model. *Plast Reconstr Surg* 1993; **92**: 255–9.
- 14 Maxwell GP, Falcone PA. Eighty-four consecutive breast reconstructions using a textured silicone tissue expander. *Plast Reconstr Surg* 1992; **89**: 1022–36.

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