CME

Microsurgical reconstruction of the breast: 'The versatile lower abdomen'

Venkat V Ramakrishnan

Division of Reconstructive Microsurgery, St.Andrew's Centre for Plastic Surgery and Burns, Broomfield Hospital, Chelmsford, UK

Address for correspondence: Venkat V Ramakrishnan, Consultant Plastic Surgeon, St.Andrew's Centre for Plastic Surgery and Burns, Broomfield Hospital, Chelmsford, CM1 7ET, United Kingdom

ABSTRACT

Since the first reported use of lower abdominal tissue from the lower abdominal skin and fat by Hans Holmstrom in 1979, there have been over 300 publications on this subject. The refinements have been aimed at the limitation of donor morbidity and to allow a predictable success of the transfer. This article analyses the landmarks and highlights the key developments in this area. The more recent development in this area - the Deep Inferior Epigastric Perforator flap is discussed.

KEY WORDS

Breast reconstruction, Free tissue transfer, Deep Inferior Epigastric Perforator flap (DIEP flap)

INTRODUCTION

The reconstruction of breast following mastectomy has become part of the management of the breast cancer today. The heightened awareness amidst woman about breast cancer along with breast screening programmes in the developed countries, has contributed to an increase in the number of surgically treated breast cancer patients. This coupled with advances in the hormonal treatment modalities, which prolong survival, allow more women with malignant breast disease to have a longer disease free survival. The quality of life issues have come to the fore in such patients and as a natural progression limitation of the psychological morbidity in these patients has gained importance.[1,2,3,4,5] In the United Kingdom the National Institute of Clinical Excellence (NICE) has recommended that all women undergoing mastectomy must be provided with relevant information about the reconstructive choices available to them.

The methods of reconstruction for the breast can be broadly divided into:

1. Implant based reconstructions
2. Autologous reconstructions

The choice of one or other route is influenced by various factors: the patient's preference; surgeon's competence; the availability of resources; short and long term morbidity associated with these procedures; the need for adjuvant therapy especially radiotherapy; patient's fitness. With the availability of more surgical skills, resources towards reconstruction of the breast, the refinements in the techniques which limit the morbidity, the increase in the use of post mastectomy

radiotherapy and the developments in anaesthesiology, the use of autologous reconstructions are on the rise.

Serafin et al first reported the use of free tissue transfers in breast reconstructions. In their patients with radical mastectomy, they had used free groin flaps to address the soft tissue defect on the chest wall, prior to using an expander and later an implant to reconstruct the breast.[6] It is ironic that this combined technique of autologous and implant based reconstruction is being considered even today in rare instances of patients with limited soft tissue cover over the chest[7] and where the Latissimus is not available.

The previously mentioned article was followed by the reported use of abdominal tissue to reconstruct the breast in 1979.[8] This was a revolutionary concept which permitted a totally autologous reconstruction of the breast, while utilising the excess in the abdominal pannus. It is of note that this method of microsurgical free tissue transfer superseded the published reports of pedicled transfers.[9,10] However, the pedicled transfers, gained popularity in the 80's due to the limitations of both availability and predictability of microvascular techniques.

The understanding of the vascular supply to the abdomen was the key to limiting the flap loss, partial or total. The most significant contribution was from the work of Taylor et al.[11] The role of subdermal plexus in the abdominal pannus was crucial to the design of the flaps from the abdomen.

There are numerous articles discussing the vascular anatomy of the lower abdominal wall. Most of these dwell on the arterial anatomy with limited reference to the venous drainage. The work of de Costa et al on the venous drainage has provided us with some understanding in this area,[12] however there is more to be analysed in this area.

The key issues in vascular anatomy of the abdominal wall: The supply is from the Deep Inferior Epigastric system, Superficial Inferior Epigastric system, Superior Epigastric system and the Intercostal vessels.

The deep system is the most dominant and consistent arterial supply to the abdominal wall. The superior and Deep Inferior Epigastric systems arborise within the Rectus Abdominis and anastomose with each other. This anastomoses is at the supra umbilical level. There are large perforating vessels, arising from the Deep inferior Epigastric system, which pass through the Rectus muscle, anterior Rectus sheath and the abdominal fat, to arborise in a plane parallel to the skin, at a subdermal level. The perforators are more consistent around the umbilicus, within a concentric circle of 8 cms. radius around the umbilicus. The perforating vessels also proceed through the Scarpa's fascia and provide a network of anastomotic channels at this level. The sub dermal anastomosis is far more dominant between these two levels of anastomoses, and this is especially so across the midline.

The Superficial Inferior Epigastric system also contributes to the subdermal plexus. This system has many anatomical variations, however the arterial side is prone for more inconsistencies than the venous pattern. A robust link between the venous side of the deep and superficial systems is a constant feature.

The Superior Epigastric system provides supply to the lower abdominal skin and fat through its anastomoses with the deep inferior system and the peri umbilical perforators. This leads to a fall in the arterial perfusion pressures in the subdermal plexus, when compared with the pressures of a flap supplied through the deep inferior system.

The Intercostal vessels enter the Rectus at its postero-lateral border and anastomose with the longitudinal Epigastric system. At times they provide perforating vessels to the abdominal skin and fat without a contribution from the Epigastric systems. This is of significance if a DIEP flap is used. In such an instance the perforating vessel may lead to the intercostals, rather than to the Deep Inferior system. Hence, one has to be cautious in elevating a DIEP flap based on a more laterally placed perforator, and in this case the dissection through the sheath and if necessary the Rectus to ascertain the origins of the perforator is

necessary prior to division of other sources of supply.

THE FREE TRAM FLAP

Following a period of popularity of the pedicled TRAM flap, the free transfer of this tissue returned. The advantages of the more robust perfusion of this tissue via the Deep Inferior Epigastric pedicle, as compared to the Superior Epigastric pedicle and the limitation of the abdominal wall morbidity were recognised.[13,14,15] This, combined with developments in microvascular techniques, made this the procedure of choice.

THE MUSCLE SPARING TRAM FLAP

In an effort to limit the morbidity to the abdominal donor site many refinements to preserve more of the Rectus muscle have been designed. The muscle-sparing TRAM allows the retaining of a medial and a lateral strip of Rectus muscle while removing a small piece of the mid segment with the deep inferior Epigastric artery and vein. The assumption here is that the lateral slip of muscle is innervated and functional. However, contrary to this belief one routinely denervates a lateral slip while harvesting a muscle sparing TRAM in view of the fact the intercostal pedicles enter the muscle not along it's lateral margin but in it's posterior surface. In fact the entry point of the nerves and vessels from the intercostals is between the junction of the middle and the lateral segment of the muscle. This results in denervated muscle in this area.

THE DIEP FLAP

Since the first description of a perforated base flap from the lower abdomen by Koshima there have been numerous publications in this area.[16,17,18] Today, DIEP flap reconstruction of the breast is considered the gold standard in reconstruction. This has been refined to minimise morbidity to the abdomen while the predictability of the transfer has increased.

As with other perforator based flaps, pre-operative assessment of the perforators facilitates the identification of the perforators pre-operatively. Although most people use a handheld Doppler probe to do this, some authors have recommended coloured Doppler mapping of the abdominal wall as a routine. Although experience of the surgeon helps in deciding which perforator to choose, it is usual to choose the largest of the perforators identified as they exit through the anterior Rectus sheath. These perforators may be from the medial or lateral branch of the deep inferior Epigastric arteries. It is usual to find them close to the umbilicus. Choice of a perforator at the lower part of the flap limits the length of the Deep Inferior Epigastric pedicle. Hence, the more cranial the perforator is, the longer the length of the vessel available. Further to identification of a perforator, the Rectus sheath is carefully opened and a course of the perforator is traced through the muscle.

As with most perforator flaps trans-mural dissection is the most difficult part of the procedure. This involves dissection of the muscle fibres close to the perforator in order to allow a tunnel to be created through which the source vessel (DIEA and V) could be reached. Twitching of the muscle is a constant problem in these cases. Instillation of Lignocaine over these fibres prior to dissection helps to suppress twitching in the muscle. The initial part of the dissection involves elevation of the lateral component of the muscle away from the perforators. This allows the dissection of the perforator and identification of its route through the muscle without having to elevate the contra-lateral side. The next step of the dissection would be to free the perforator from the medial segment of the muscle. Damage to the fine branches of the perforating Venae Commitantes is of great concern in the dissection of the perforator complex through the muscle.

Once the posterior Rectus base is free there are three ways to proceed with the dissection. Dissection of the Deep Inferior Epigastric artery and it's branches along the posterior surface of the Rectus muscle could be undertaken either through a linear opening in the muscle (trans-mural), or, through mobilisation of the muscle off the posterior Rectus sheath via the medial route, or through a lateral route. Dissection through the lateral border of the muscle has to be undertaken very carefully in view of the intercostal nerves entering along the side. Especially denervation of the muscle

below the arcuate line would produce at least an abdominal bulge despite the fact that most of the muscle or all of the muscle is left behind.

Closure of the abdomen is by suturing the anterior Rectus sheath only. No mesh repair is required in this instance. In view of the fact that anterior Rectus sheath is not resected, there is limitation of the shift of the umbilicus to one side or the other which is quite common when forming a standard TRAM flap.

The pedicle in a DIEP flap is long and is of a very small bore close to its entry point into the flap, the problem of torsion and avulsion are higher in these flaps compared to the conventional free tissue transfers. It is essential that the torsion is corrected prior to inserting the flap. It is common practice to use the thoracodorsal pedicle if one was doing an immediate reconstruction using a skin sparing mastectomy technique. If a delayed reconstruction is undertaken it is more often the internal mammary that is the pedicle of choice.

There has been much debate about the use of either recipient vessels. The proponents of the internal mammary vessels as the choice recipient suggest that this allows for the medialisation of the breast mound and that this artery has higher perfusion pressures. However, approach to this pedicle may be difficult if the mastectomy was carried out through a peri areolar incision. Further, if the axillary clearance had been carried out through a separate axillary access, this allows excellent exposure to the thoraco dorsal pedicle. With longer pedicle lengths available with a DIEP flap, it is possible to place the flap more medially, and provide an acceptable result.

CONCLUSION

The developments discussed above have brought us from the pedicled TRAM to the DIEP flap. Through this journey we have limited the donor morbidity to the abdominal wall reliably. However, we may have lost some of the robustness of the vascular supply in the bargain.

The search for the ultimate flap donor site for the reconstruction of the breast has come to rest in the lower abdomen. Scott Spear in his textbook "The Surgery of the Breast" says ' the only procedure that I can imagine that will ever replace this procedure (i.e. The DIEP flap) would be the transfer of homologous tissue from a tissue bank, where there is no morbidity whatsoever associated with the operation'. The subtle refinements to increase the ease of transfer and limitation of the donor morbidity will continue. The wider acceptance of microvascular procedures to reconstruct the breast is only limited by the availability of skills and resources.

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