Microsurgery – The Birth of Free Tissue Transfer

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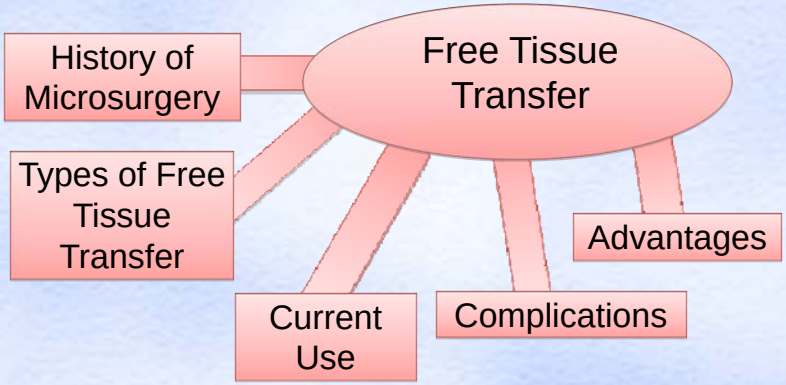
Abstract

Prior to the development of the operating microscope, micro-instruments and fine suture materials in the late 1950s plastic surgeons were limited to using local pedicled flaps for reconstruction and were unable to reattach amputated limbs or digits[1].

Introduction

Microsurgery enables the anastomosis of small blood vessels and nerves facilitating the transfer of tissue from one region of the body to another, a process known as free tissue transfer.



The History of Microsurgery

Fig 1. Harry J. Bunke in Theatre[2]

American plastic surgeon Harry J. Bunke, regarded by many as the father of microsurgery, performed the first rabbit ear transplantation in 1964 from his garage using homemade instruments, this was an important accomplishment since vessels of similar size to those found in the human hand were reattached[3].
Five years later Bunke and Donald McLean performed the first free tissue transfer using free autologous omentum to repair a skull defect.
In 1968 English surgeon John Cobbett reported the first great toe transfer to replace an amputated thumb[4] laying the foundations for composite free tissue transfer which was later refined during the 1970s and 80s.

Free Flaps Today

Today success rates as high as 98%[5,6] are possible for certain tissue transfer procedures with choice of flap and recipient site influencing tissue survival[7].

Types of Free Tissue Transfer

Free tissue transfers can be classified into two main types. Isolated transfers of individual skin flaps, fascia, nerve or bone and composite tissue transfers containing more than one tissue type such as myocutaneous or osteocutaneous flaps.

Current Use

Today free flaps are used in numerous reconstructive centres throughout the world. Free tissue transfer may be used for a number of reasons including:

- Functional restoration – e.g. mandible reconstruction with a fibula osteocutaneous flap following surgical removal of a cancer from the head or neck
- Cosmetic reconstruction – e.g. a TRAM or DIEP flap following mastectomy
- Traumatic reconstruction – e.g. latissimus dorsi muscle flap to an open tibial fracture

Advantages

Advantages of free tissue transfer include:

- The ability to reconstruct a defect immediately
- The ability to use a wide variety of tissue
- Minimal donor site morbidity
- Stable wound coverage
- Improved functional and aesthetic outcomes

Complications

Loss of venous outflow e.g. from a clot, loss of arterial supply and infection are all possible causes of flap failure.
Flaps are closely monitored post-operatively, sometimes with an implantable Doppler probe[9]. Failing flaps identified early (<6hrs) have a high chance of salvage[10].

An Example Procedure – DIEP Flap for Breast Reconstruction

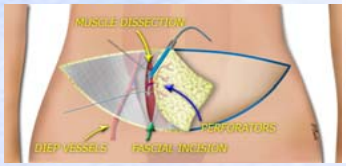


Fig. 2a Dissection of DIEP flap[8]

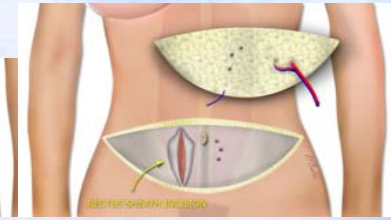


Fig. 2b Isolation of DIEP flap

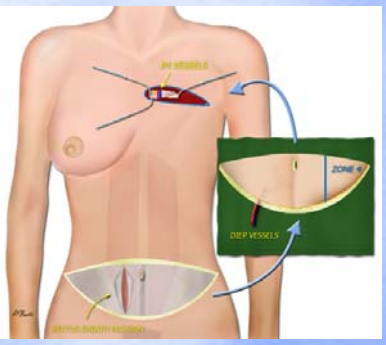


Fig. 2c Microsurgical anastomosis

The deep inferior epigastric perforator flap, together with transverse rectus abdominus myocutaneous (TRAM) and superior gluteal artery perforator (SGAP) flaps, is an example of a free flap used to provide cosmetic reconstruction following mastectomy. Although this is a specific example the overall method of selecting, isolating and then microsurgically attaching a flap to a recipient blood supply can be applied to any free tissue transfer.
In this example the surgeon will first mark the area for removal before making an incision and carefully dissecting out the DIEP vessels (Fig. 2a). When the entire flap remains attached to only one perforator, and the recipient area is prepared, the perforator is ligated and the flap isolated (Fig. 2b). Circulation is then restored to the DIEP flap by microsurgical attachment to the internal mammary vessels (Fig. 2c).

References

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