Clinical review

Recent developments in plastic surgery

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Misconceptions still abound that plastic surgeons are predominantly cosmetic surgeons. Plastic surgery is a technique based specialty with the aim of reconstructing tissue so that patients gain normal function and appearance. As a result plastic surgery encompasses a vast range (see box and bmj.com). Our review focuses on advances in surgical techniques, technical and biological advances (see also bmj.com), and changes in the organisation of plastic surgery, with its intergration with other specialties.

Methods

We selected topics for review by searching Medline from 1 January 1998 and by reviewing abstracts from the past four annual meetings of the British and American Associations of Plastic Surgeons, the Congress of the International Confederation of Plastic, Reconstructive and Aesthetic Surgery, and the International Society of Craniofacial Surgeons.

Surgical advances

Microvascular free tissue transfer

The development of microsurgical techniques has made it possible to replant severed body parts, ranging from whole limbs to fingertips, by anastomosing the divided blood vessels along with nerves and other injured structures. Success depends on the mechanism of injury (clean cuts do better than crush injuries), the correct management of the amputated part (keeping it cool but not frozen), prompt surgery (ideally within a few hours of injury), and the skill of the microsurgeon.

Conditions treated by plastic surgeons

- Congenital abnormalities
- Breast surgery
- Trauma
- Oculoplastic conditions
- Hand surgery
- Malignancy
- Reanimation for facial palsy
- Burns
- Aesthetic surgery
- Laser surgery
- Chronic wound management
- Vascular malformations

Recent developments

Microvascular free tissue transfer is part of routine plastic surgical practice

Surgical advances in microvascular free tissue transfer have focused on reducing morbidity at the donor site

A range of technological and biological advances promise to lead to improvements in the management of nerve injury, skin cancers, and wounds

Pioneering surgery involving neuroelectric stimulation of limb muscles in tetraplegic patients can restore hand function

The integration of plastic surgery into hospital practice has paralleled a multidisciplinary approach to the management of many conditions

All patients with breast cancer should have the opportunity for a consultation with a plastic surgeon who can offer the entire range of reconstructive breast procedures

A wealth of recent anatomical research detailing blood supply to the skin and underlying muscles and bones has made it possible to transplant specific territories of skin, individual muscles, and segments of bone (separately or in combination) to reconstruct a volume defect anywhere in the human body. This is known as free tissue transfer and is achieved by disconnecting the blood supply of the tissue to be transferred (the donor tissue) and reconnecting these vessels to different vessels at their new location in the same patient. This technique is so flexible that it has rapidly become routine practice in plastic surgery, with a success rate of over 95%.[1–3] Free tissue transfer has essentially made obsolete the previously lengthy and complex multistage reconstructions such as that of the tube pedicle techniques—for example, tumour resection in patients with head and neck cancer may create large defects in the mandible and floor of the mouth, which can be reconstructed from the fibula bone and overlying skin raised on the peroneal vessels in the lower leg. Similarly, absent fingers, whether congenital

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A box, text, and three figures appear on bmj.com

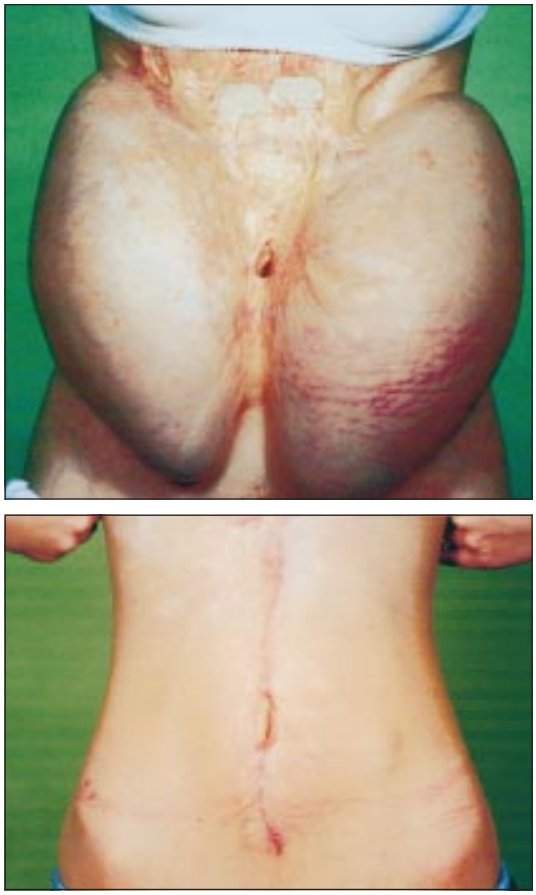

Fig 1 (Top) Expanders inflated to generate tissue for reconstruction of abdominal wall scarred from burns. (Bottom) Early results after reconstruction. Reproduced with patient's permission

or caused by trauma, can be reconstructed with transplanted toes,[4] and facial movements in patients with facial palsy can be reanimated by anastomosing the nerve supply of a transferred muscle to a nerve graft attached to the normal facial nerve on the opposite side of the face.

Clearly it is important to consider morbidity at the donor site when choosing potential tissues for transfer. This is currently being addressed. For example, some flaps such as the gracilis muscle can be harvested endoscopically to limit the length of the donor site incision. Also, when harvesting a musculocutaneous flap the intramuscular blood vessels that supply the overlying skin can be dissected free as they pass through this muscle, allowing the muscle to be left in situ rather than be harvested along with the skin. Skin flaps raised in such a way are called perforator flaps. Another advance concerns increasing the area of skin supplied by a given blood vessel by tissue expansion. Here the expander—an inflatable balloon—is placed beneath the skin and inflated by regular injections of saline over several weeks until the skin is sufficiently stretched. This generates a good quantity of skin for transfer without creating a secondary donor skin defect (fig 1).

Prefabrication

Another recent advance has been the manipulation of blood supply to an area of skin. This process, called prefabrication, enables a territory that was unsuitable because of its blood supply to be converted into one appropriate for transfer.[5]

Prelamination

Tissue can be "prelaminated" before transfer. For instance if a nose is to be totally reconstructed it can be first created on a forearm with cartilage and bone grafts under the skin before it is transferred to the face.[6 7] This allows the surgeon to sculpt the tissues and to identify and compensate for any resorption of cartilage or bone graft before transfer.

Allogenic tissue

The logical extension of prefabrication and prelamination is the transplantation of allogenic tissue. Hand transplantation has already been performed in the past three years but requires life long immunosuppression with its accompanying side effects.[8] It is not beyond the realms of fantasy to suggest the transplantation of breast or facial tissue if these side effects are deemed justifiable.

Technological and biological advances

Sentinel node biopsy

The importance of identifying patients with primary melanoma at greater risk of recurrence became apparent after a randomised trial of adjuvant interferon alfa-2B.[9] The procedure called sentinel lymph node mapping and biopsy is over 95% accurate in staging clinically negative nodal basins at risk of regional metastases in patients with primary cutaneous melanoma.[10] Determining the status of sentinel lymph nodes is the most important prognostic factor in determining the risk of recurrence, although it may have doubtful therapeutic value in terms of survival.[11 12] Mapping involves lymphoscintigraphy, with the intradermal injection of radiolabelled technetium-99m sulphur colloid on the day of surgery and the intradermal injection of isosulfan blue dye around the site of the wider excision of the primary lesion immediately before surgery. The sentinel lymph node is identified either from the blue dye or as the node with the most ^{99m}Tc incorporated. All sentinel lymph nodes are removed and analysed histologically. Evidence of metastases in the sentinel lymph node determines the decision to undertake excision of the complete lymph node basin.

Current recommendations state that sentinel lymph node mapping and biopsy should be offered to

Fig 2 Vacuum assisted closure of leg wound. Reproduced with patient's permission

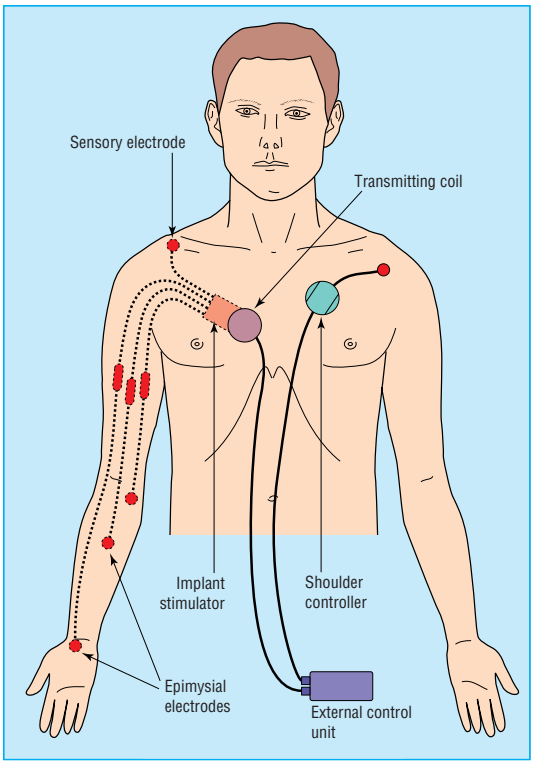

Fig 3 Tendon transfers and electrode implantation for restoration of hand function in tetraplegic patients (see bmj.com)

patients with intermediate thickness melanomas only (Breslow tumour thickness 1-4 mm) in a multidisciplinary setting as part of a clinical trial.[13] These trials will be important in determining the outcome of patients undergoing sentinel lymph node mapping and biopsy.

Vacuum assisted wound closure

Continuous negative pressure applied to a wound is now an established method for managing patients' wounds in hospital. Negative pressure is generated by a vacuum pump. The pump is connected by a tube to a surface sealed open foam dressing on the wound (fig 2). The pressure promotes the formation of granulation tissue at the base of the wound and recruits adjacent skin and soft tissue from the wound edges. This helps to speed up the healing process by reducing the surface area of the wound.[14 15] Many wounds can ultimately be closed by a simpler surgical procedure than would otherwise be required. It may not be appropriate for all wounds, and until randomised trials are performed it is difficult to predict which wounds are likely to benefit most. This technique promises to be a powerful adjunct to the surgical management of difficult wounds as well as a potential community based treatment for chronic wounds.

Restoration of hand function in tetraplegic patients

Pioneering surgery involving transfers of multiple tendons together with the implantation of up to eight electrodes in the muscles of the forearm and hand has improved the quality of life of many patients with tetraplegia.[16 17] The electrode wires are tunnelled up the arm to a control box located under the skin in the pectoral region. A movement detector is placed externally on the opposite shoulder. When the patient elevates and depresses or protracts and retracts this shoulder the movement is relayed to the control box, which is programmed to coordinate the activity in the electrodes and cause the hand to open and close. This provides a key pinch and a palmar grasp and allows the patient to perform the manoeuvres for eating, drinking, and writing (fig 3). About 200 people worldwide have had this treatment, and 16 procedures have been performed at our hospital, currently the largest centre in Europe performing this type of surgery. Further advances in this technology are likely to lead to huge benefits in the treatment of patients with spinal injuries and those with other neurological problems.

Organisational advances

A major recent advance in plastic surgery has been its move away from isolated regional centres to the recognition that reconstructive plastic surgery is an integral part of hospital practice. In the past plastic surgery was perceived as a last resort for hopeless cases, yet the early involvement of plastic surgeons is the key to optimising outcomes. The British Orthopaedic Association and the British Association of Plastic Surgeons have produced joint guidelines on the management of open tibial fractures, recognising that the risk of osteomyelitis and non-union are reduced when both orthopaedic and plastic surgeons are involved.[18]

Many subspecialties within plastic surgery are centred around a multidisciplinary approach to management, acknowledging that the overall support and care of patients rely on carefully coordinated management between many medical and surgical specialist groups. For example, children with congenital craniofacial abnormalities are seen in specialist clinics comprising a craniofacial plastic surgeon, a neurosurgeon, a specialist craniofacial link nurse, a clinical geneticist, a child psychologist, and an ophthalmologist. This team approach is now established practice for patients with cleft lip and palate, head and neck cancer units, burns

Fig 4 Early appearance after reconstruction of left breast with autologous tissue from abdomen. Note abdominal scar of donor site and relocation of umbilicus. Reproduced with patient's permission

Additional educational resources

Useful websites

British Association of Plastic Surgeons (www.baps.co.uk)
General aspects of plastic surgery in the United Kingdom

Vacuum therapy (www.vacuumtherapy.co.uk)
Information on all aspects of vacuum therapy for wound management

Salisbury Health Care NHS Trust (www.Salisburyfes.com)
Information on restoration of hand function in tetraplegic patients from the Functional Electrical Stimulation Research, Development, and Clinical Service at Salisbury District Hospital

Information for patients

Breast Cancer Care (www.breastcancercare.org.uk) and Cancer BACUP (www.cancerbacup.org.uk)
Information on breast reconstruction

Plastic Surgery Information Service (www.plasticsurgery.org)
Website primarily aimed at patients and sponsored by the American Society of Plastic Surgeons

units, centres carrying out complex hand surgery, and breast care units.

Immediate breast reconstruction

All patients with breast cancer should have the opportunity for a consultation with a plastic surgeon to consider the options for both wide local excision and mastectomy. For example, depending on the size and shape of the breast it may be possible to incorporate a wide local tumour excision into a bilateral breast reduction procedure, with the aim of achieving symmetry of the breasts. It is possible to customise such procedures provided consideration is given early on.

Evidence is well documented of the psychological, cosmetic, and cost advantages of performing reconstruction at the same time as mastectomy.[19 20] No evidence has been found of a detrimental effect on subsequent oncological therapy or survival.[21–24] Many breast departments have plastic surgeons as members of their team, which allows rapid assessment, counselling, and surgery on women requiring mastectomy.

Breast reconstruction can be performed with implants or autologous tissue. Skin is removed with breast tissue during mastectomy so needs to be replaced during reconstruction. This can be achieved either by stretching the remaining skin with a tissue expander or by transferring skin based on the latissimus dorsi muscle from the back to the anterior chest wall. With concerns over the safety of particular breast implants there has been an increasing demand for implant free techniques; the most common uses skin and fat from the lower abdomen, which gives a good amount of tissue to reconstruct even a large breast. Good symmetry of size and shape is achievable with this technique, and it avoids the cost and long term concerns of using an implant (fig 4). The use of autologous tissue often necessitates free tissue transfer and hence the need for plastic surgeons as part of the breast care team.

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Endpiece

The virtue of surgery

Surgery is the best of the medical sciences; less liable than any other to the fallacy of conjectural or inferential practice; pure in itself; perpetual in its applicability; the worthy produce of heaven and the certain source of fame.

Dhanwantaree, c 600 BC

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