The role of plastic surgery in reconstruction after oncological surgery

One in three people is affected by cancer in their lifetime. Surgical treatment commonly has the greatest impact on long-term survival, so a large proportion of patients undergo major oncological resection. This is the first in a symposium of four articles describing plastic surgical reconstruction after oncological resection.

Cancer is likely to directly affect all of us in our lifetime, as it is a leading cause of death worldwide with a reported one in seven deaths attributable to cancer in 2012 (American Cancer Society, 2015; National Cancer Institute, 2016). Currently the 5-year survival rate for all cancers combined is 50%. Patients are now living longer following their diagnosis and treatment, so it is increasingly important to achieve low morbidity from cancer treatment and high quality of life indices postoperatively. This article introduces the management pathways for cancer treatment and provides insight into the reconstructive options available to a patient in the UK.

Role of the NHS

The Department of Health appointed Professor Sir Mike Richards, an oncologist, as National Clinical Director for Cancer in 1999. His responsibilities included ensuring high priority for cancer services and securing resources and improvements to services and outcomes. He led the development of the *NHS Cancer Plan*, published in September 2000. The aims of the *NHS Cancer Plan* were to deliver the fastest improving cancer service in Europe with regards to prevention, diagnosis, treatment, care and research. Following the *NHS Cancer Plan* funding for cancer services increased from £3.4 billion in 2003 to £5.8 billion in 2010 (Beer and James, 2012).

Another achievement of the *NHS Cancer Plan* was the implementation of the national cancer networks in 2000, after this was originally proposed by the Calman-Hine report in 1995. The aim of the cancer networks is to coordinate cancer treatment in specific geographical areas through planning, commissioning and delivery of cancer care. There are 28 cancer networks in England, two in Wales and three in Scotland. Cancer networks currently only involve acute care professionals, but the aim is to expand the groups to include a wider mix of health-care professionals.

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Oncological surgery

The Association for Cancer Surgery

The Association for Cancer Surgery, known as BASO, was formed in 1972 and is an umbrella organization for surgeons treating patients with cancer. Over the past 40 years BASO has acted as a forum for surgical research and training to benefit patients with cancer. It runs regular scientific conferences, fellowships and courses, in addition to a surgical oncological trainee association that is free for trainees to join. BASO publishes its own journal, the *European Journal of Surgical Oncology*.

Multidisciplinary teams

Oncological surgery is carried out by the relevant surgical speciality following liaison with a locally based multidisciplinary team. Multidisciplinary teams are mandatory within the NHS for any hospital providing cancer services and are subject to peer review on a regular basis. The objective of a multidisciplinary team meeting is to improve patient outcome. Current guidelines in England request a maximum time of referral to diagnosis of 31 days and to treatment of 62 days. In Scotland all patients should start treatment within 62 days of referral and in Wales all patients should receive treatment within 2 months of receipt of the referral. Guidelines for referral to the cancer multidisciplinary team are trust specific. Cancer multidisciplinary teams typically contain representatives from the relevant surgical specialties, oncology, palliative care, pathology, clinical radiologists, specialist nurse practitioners and a multidisciplinary team coordinator.

Types of cancer requiring reconstruction

Surgical treatment has the greatest impact on long-term survival in most types of cancer (National Cancer Intelligence Network, 2011). With increased surgical treatment the role of reconstruction after surgical resection is becoming increasingly important. Breast, colorectal, gynaecological and skin cancers commonly require reconstruction.

Skin cancer

Skin cancer provides a large proportion of reconstruction work referred to plastic surgeons. Skin cancer incidence is rising and plastic surgery units have regular local and general anaesthetic skin cancer operating lists during the week. *Figure 1* demonstrates the rising incidence of malignant melanoma, now the fifth most common cancer in the UK (Cancer Research UK, 2015).

Cancer management guidelines

The National Institute of Health and Care Excellence issues guidelines on the management of different types of cancer, which are available on their website. The professional bodies representing individual surgical specialties also provide specialty-specific guidance, available through their websites. For example, head and neck cancer guidelines are provided by the British Association of Otorhinolaryngology, skin cancer management guidelines by the British Association of Dermatologists and breast surgery guidelines by the Association of Breast Surgeons. The British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS) have produced oncoplastic breast reconstruction guidelines in conjunction with the Association of Breast Surgeons.

Role of plastic surgery

Background

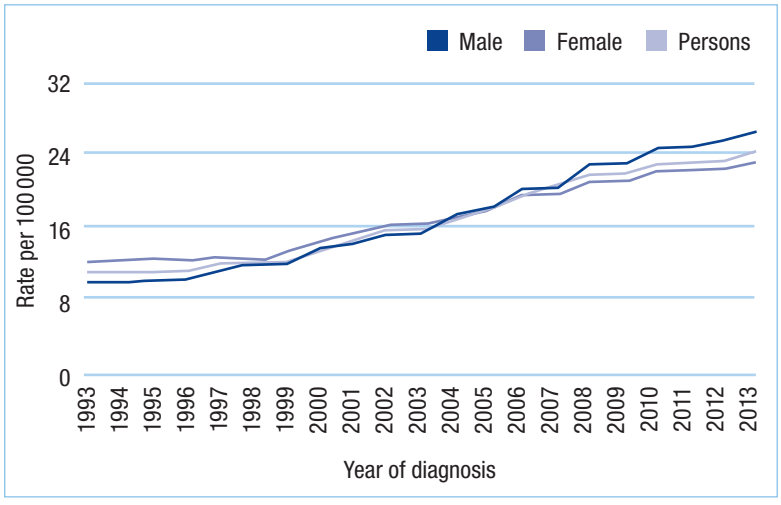
The public equates plastic surgery with cosmetic surgery and unfortunately plastic surgery is not routinely covered in the undergraduate medical syllabus. However, plastic surgery is actually the art of reconstruction to restore form and function. Cosmetic surgery (only offered in the NHS for extenuating circumstances) is the art of improving aesthetics where there is no significant underlying pathology. In many plastic surgery departments over 50% of elective procedures are cancer related.

Plastic surgeons are increasingly involved in cancer multidisciplinary team meetings for patients with breast, head and neck, skin and colorectal cancers. Once the primary oncological surgery has been undertaken by the relevant surgical team, the plastic surgery team is involved, in conjunction with the primary surgical team, to reconstruct the defect caused by cancer excision either immediately or at a later stage (delayed reconstruction). The role of a plastic surgeon is important as the prior knowledge that a defect can be repaired means tumours can be excised completely to ensure adequate oncological clearance, without fear of causing major morbidity. In addition it allows the patient to have an enhanced functional and aesthetic result that may not be available with oncological resection alone.

British Association of Plastic, Reconstructive and Aesthetic Surgeons

BAPRAS was founded in 1946 after World War II. BAPRAS provides information for patients regarding reconstructive surgery, and conducts its own research and teaching activities. The BAPRAS website lists 65 NHS hospital units and clinics in the UK where plastic surgery is carried out.

Figure 1. Increase in malignant melanoma cases over time – European age-standardized incidence rates, by sex, UK, 1993–2013. From Cancer Research UK (2016).



BAPRAS led the National Mastectomy and Breast Reconstruction Audit (2011) in conjunction with the Association of Breast Surgery and the Royal College of Surgeons. Following the results where only 65% of patients felt they received the right amount of reconstructive information, the authors believe it would be beneficial to all patients with any type of cancer requiring a major resection to have plastic surgeons involved within their cancer multidisciplinary teams. This may reduce the morbidity associated with major resection for cancer and improve quality of life indices for these patients.

Reconstructive ladder

The reconstructive ladder (*Figure 2*) is a useful adjunct in the plastic surgery decision-making process. It was designed to help the plastic surgeon manage wounds with skin and soft tissue loss. There is a stepwise progression from minor to major operative interventions to manage

Figure 2. Reconstructive ladder.

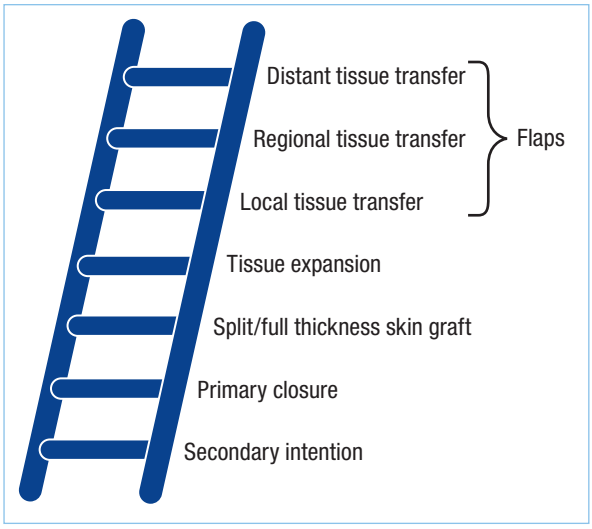


Figure 3. Basal cell carcinoma on cheek amenable to direct closure.

increasingly complex wounds. For example, smaller lesions are amenable to direct closure (*Figure 3*) but larger lesions (*Figure 4*) may require use of the reconstructive ladder.

The first two rungs comprise healing by secondary and primary intention. Healing by secondary intention occurs when the wound is left open and allowed to heal by the processes of haemostasis, contraction and re-epithelialization. Healing by primary intention involves debridement of a wound and direct closure where the wound edges are brought together by sutures or clips. If the wound is too complex to allow healing via these two options then the surgeon progresses up the ladder.

The next two rungs include skin grafting techniques, which can be either partial or full thickness. Partial thickness grafts (also known as a Thiersch graft) are composed of the full thickness of the epidermis with a very thin layer of dermis. Partial (split) thickness skin grafts are commonly harvested from the thigh or buttocks using a dermatome. *Figure 5* demonstrates the stages of harvest of a split thickness skin graft. *Figure 6* demonstrates a skin graft at 1 week and at 1 year postoperatively. Full thickness grafts (or Wolfe grafts) are composed of both layers of skin. These are commonly harvested from pre- or postauricular areas, supraclavicular region or the antecubital fossa using a scalpel. Skin grafts do not grow hair. Skin grafts can only be used in situations where there is a vascularized bed to graft on to, e.g. muscle, subcutaneous tissue. Non-vascularized beds include bone, tendon missing paratenon or implants, and in such cases the plastic surgeon needs to progress to the next rung of the reconstructive ladder. There is an increasing role of acellular dermal matrices, e.g. Strattice and AlloDerm, that have been manufactured commonly from either bovine or porcine collagen. They can be used to reinforce existing skin or replace missing skin and are incorporated by the body with no immune reaction.

Tissue expansion is a useful tool to provide skin cover with local skin thereby producing a good match in terms of skin colour. Tissue expansion involves placement of an expander implant made from silicone, which is connected to a port that lies close to the skin. This port can be accessed easily through the skin via a needle for purposes of expanding the implant. Expanding the implant causes skin expansion through the processes of creep and stress relaxation. Microscopically the process of tissue expansion causes thickening of the epidermis through cellular hyperplasia and thinning of the dermis through fragmentation of elastin. Tissue expansion can be used in situations where extra skin is required before placement of a permanent implant, e.g. post-mastectomy patients who wish to have breast reconstruction with breast implants, or in situations where like for like is required, e.g. scalp tissue loss where hair-bearing skin is required. If there is loss of subcutaneous and muscle layers and these are required to provide adequate cover and encourage healing of a defect, e.g. following a pelvic exenteration, then the surgeon must progress to the final rungs of the ladder.

A flap is a unit of tissue that has its own blood supply and is moved from a donor site to the recipient site. A flap can be composed of one or a combination of skin, subcutaneous tissue, fascia, muscle and/or bone. In addition to classifying flaps based on their composition, flaps can be defined according to their original location, i.e. local, regional or free (distant) flaps. Local and regional flaps have their own blood supply that is not interrupted. A local flap is tissue that lies adjacent to the defect and is moved to fill the space. *Figure 7* demonstrates commonly used local flaps and *Figure 8* demonstrates use of a rhomboid flap to reconstruct a defect on the temple. A regional flap is one that lies in the same anatomical area as the defect. A free flap is one that is moved with its own blood vessels from an anatomical region distant to the defect and then anastomosed into recipient blood vessels at the defect. There are a great number of free flaps described in the literature

Figure 4. Reconstruction of lower eyelid defect using a local flap.

Figure 5. Harvesting of a split skin graft for reconstruction of a scalp defect. Note previous healed split skin graft adjacent to defect. **a.** Preoperative marking of donor site on thigh. **b.** Dermatome. **c.** Using dermatome to harvest split skin graft from thigh. **d.** Split skin graft (suture packet can be visualized through graft demonstrating the thinness required). **e.** Split skin graft inset onto scalp defect. **f.** Tie over dressings over split skin graft on scalp.

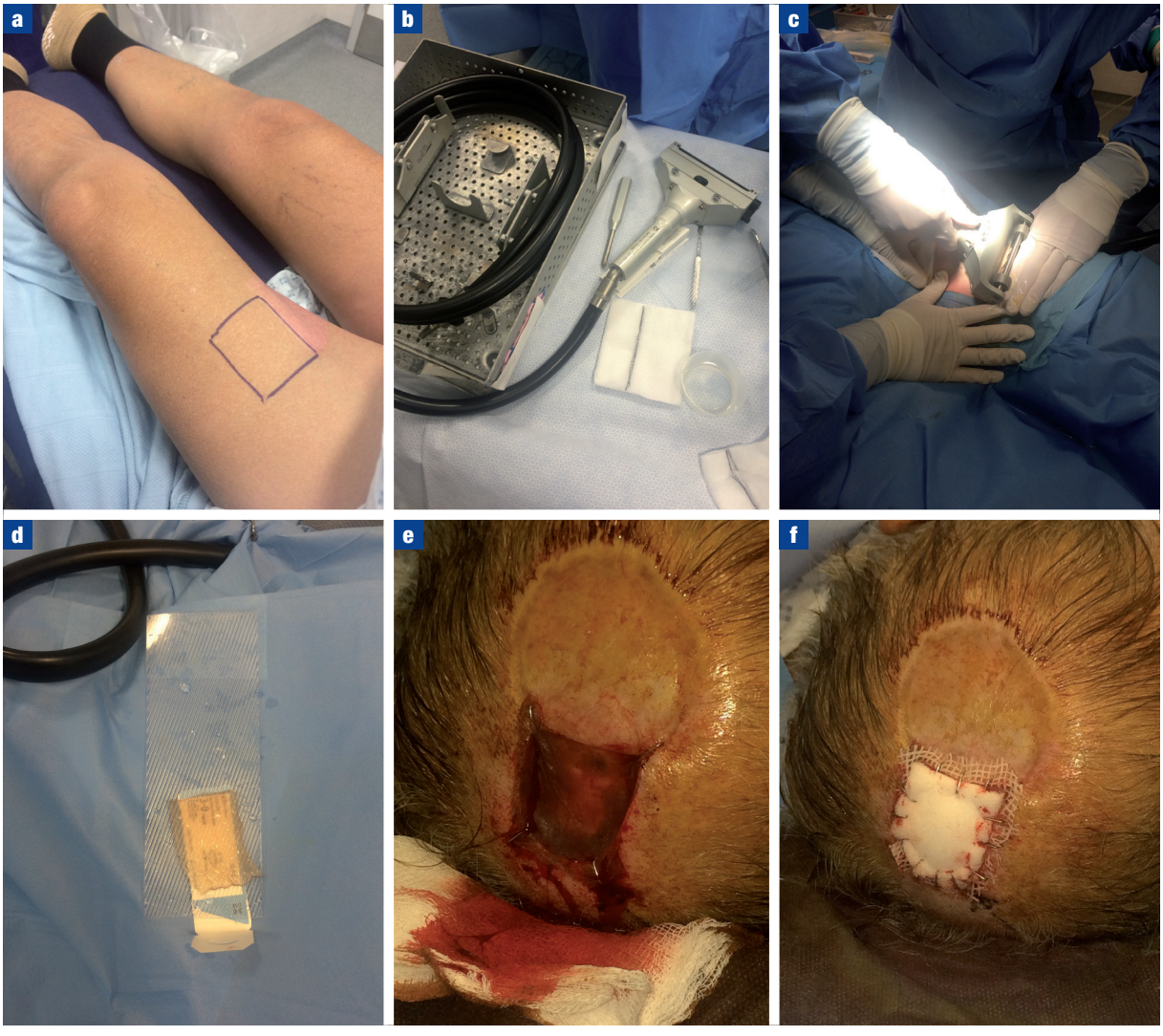


Figure 6. **a.** Meshed split skin graft left upper arm at 1 week. **b.** Meshed split skin graft left upper arm at 1 year.

Figure 7. Examples of local flaps used to close skin defects and the resulting scars.

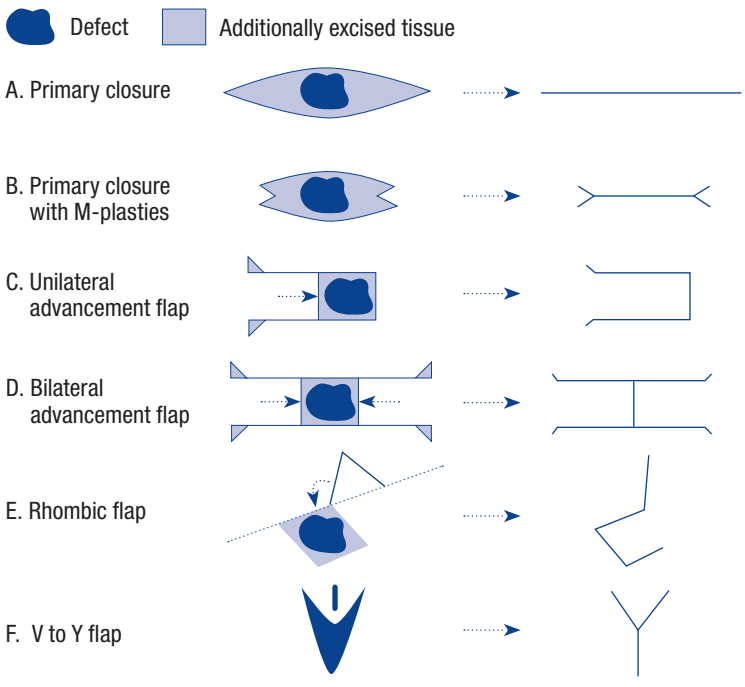


Figure 8. A rhomboid flap used to close a defect on the cheek.

FURTHER INFORMATION

- NHS Information Centre www.ic.nhs.uk/services/national-clinical-audit-support-programme-ncasp/cancer
- National Cancer Research Network www.ncin.org.uk
- Cancer Research UK www.cancerresearchuk.org/home
- Macmillan Cancer Support www.macmillan.org.uk
- British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS) www.bapras.org.uk
- The Association for Cancer Surgery (BASO) www.baso.org

(*Figure 9*) and the modern plastic surgeon therefore has a large armamentarium at their disposal with which to reconstruct defects. These free flaps will be discussed in detail in the subsequent articles in this symposium.

Factors affecting reconstruction

Table 1 outlines the different factors that need to be considered before undergoing a reconstruction procedure. These are grouped into factors involving the defect, the possible donor site and patient-related factors.

Timing of reconstruction

Treatment of cancer commonly involves surgical clearance followed by a reconstruction procedure that is either immediate or delayed. Some types of cancer often require neoadjuvant or adjuvant systemic therapies, such as chemotherapy or radiotherapy, as well as surgical treatment. Use of systemic therapies is associated with higher rates of complications in some plastic surgical procedures, so following a discussion with the multidisciplinary team and the patient, reconstruction in such patients may need to be delayed.

The benefits of early reconstruction include decreased psychological morbidity, presence of a virgin operating field and an improved cosmetic outcome. The disadvantages of early reconstruction include the sequelae of postoperative radiation damage and possible delay to chemotherapy.

Radiotherapy is linked to fibrosis of tissues and an increased contracture rate around silicone implants, therefore potential radiotherapy treatment can influence decision making with regards to use of implants for reconstruction. The high complication rate with silicone implants post radiotherapy is well recognized with rates of 40–60% described (Jugenburg et al, 2007; Kronowitz and Robb, 2009). Studies on neoadjuvant or adjuvant chemotherapy in patients undergoing treatment and reconstruction for breast cancer have shown no increase in non-infectious postoperative complications (Warren Peled et al, 2010). However, there is a reported higher risk of wound infection in patients receiving adjuvant chemotherapy, leading to a delay in their chemotherapy treatment.

As radiotherapy and chemotherapy increase the risk of postoperative complications, preoperative planning should be done in conjunction with oncology colleagues. It may be advisable, where possible, to delay complex reconstruction in patients requiring adjuvant chemotherapy, to prevent any delay to their chemotherapy treatment. Finally all planned surgery should be discussed with the anaesthetist because of the systemic effects of chemotherapy and radiotherapy and the potential complications that may arise.

Conclusions

The incidence of cancer is rising; fortunately survival rates are increasing too. This means many patients are left with significant functional and aesthetic morbidity following their primary oncological surgery. The role of the plastic surgeon is to reconstruct form and function and it is

important to include this specialty in the multidisciplinary team planning of cancer treatments for individual patients. The following three articles delineate in further detail the specific plastic surgical procedures available to reconstruct the breast, the head and neck region, and the gynaecological and rectal areas following oncological surgery. **BJHM**

Figure 1 *is reproduced by kind permission of Cancer Research UK and* Figure 7 *is reproduced by kind permission of Medscape. The authors would like to thank Mr Giles Bantick for the intraoperative photograph series used in* Figure 5. *Conflict of interest: none.*

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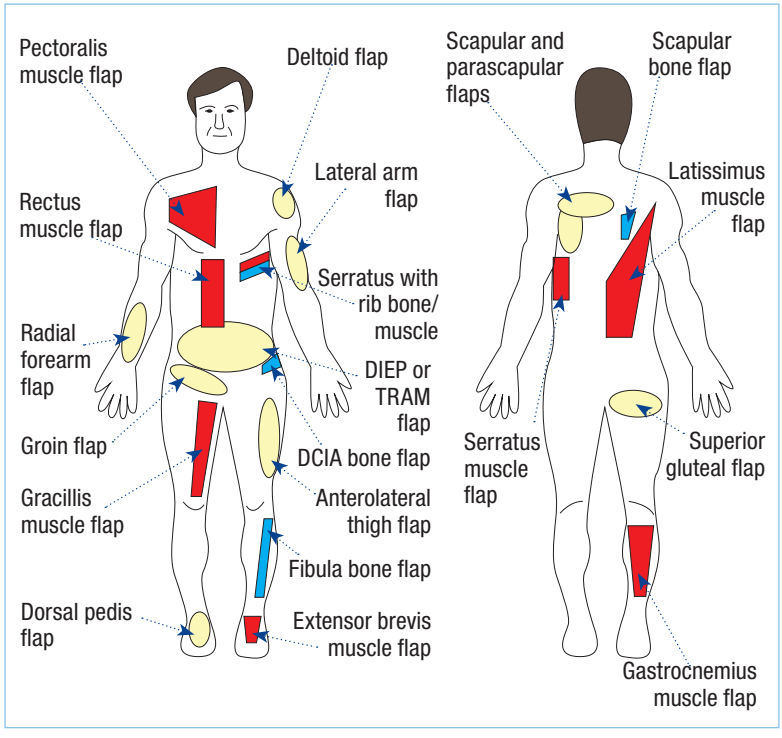
Figure 9. Examples of flaps raised from different anatomical regions. DIEP = deep inferior epigastric artery perforator flap; DCIA = deep circumflex iliac artery flap; TRAM = transverse rectus abdominis flap.



KEY POINTS

- Cancer is a leading cause of death worldwide.
- Surgical resection is an important treatment modality in the management of cancer.
- Reconstruction post oncological clearance should be considered as it may improve patient outcomes and quality of life.

Table 1. Factors affecting reconstructive options

Defect	■ Size ■ Anatomical location ■ Structures missing, e.g. skin, muscle, bone ■ Previous radiotherapy or need for postoperative radiotherapy ■ Infection ■ Functional and aesthetic goals ■ Calibre of recipient vessels (if free flap to be used)
Donor site	■ What structures need to be replaced? ■ How is donor site to be closed and related morbidity? ■ Surface area and thickness of flap ■ Calibre of donor site vessels (if free flap to be used)
Patient factors	■ Age ■ Medical comorbidities affecting flap healing, e.g. diabetes, immunosuppression, vascular disease ■ Medical comorbidities precluding long or complicated surgery ■ Smoking ■ Nutritional status