Ten top tips: skin grafting

Authors:
Joyce Black and Jonathan Black

Skin grafting is a common method of surgical wound closure. Partial (split) and full-thickness skin grafts are the two main categories of skin grafting, each with their pros and cons. Generally, skin grafting is used when other methods of reconstruction such as primary closure, second-intention healing, or local skin flaps are inappropriate, unavailable, or would produce a suboptimal result. Many people use the term "graft" and "flap" synonymously; these methods of reconstruction are not the same thing. Flaps are designed to contain arteries and veins for perfusion. These ten top tips are designed to guide care of the patient with a skin graft.

1 Skin grafts are the intentional transplantation of a portion of healthy skin to close an open wound: Skin grafts are commonly taken at the mid-dermal layer, hence the name 'partial thickness'. This approach allows the donor site to heal secondarily and if needed can supply another skin graft in the future. As wound care providers, split-skin grafts are used to repair venous leg ulcers and burns. Full-thickness skin grafts are often used for the face as they have cosmetically superior results. The surgical removal of skin cancer is often repaired with full thickness skin grafts. Split-thickness skin grafts (STSGs) may be further subdivided into thin (0.008 to 0.012mm), medium (0.012 to 0.018mm), and thick (0.018 to 0.030mm) grafts. This depth is obtained by setting the device used to harvest the graft *[Figure 1]*.

2 Keep the donor site covered with occlusive dressings: Tissue from where the graft is taken is called a donor site. Dermatomes are commonly used instruments to obtain a large split graft; smaller grafts can be harvested by hand. Usual donor sites are the upper thigh, abdomen, or any large, flat area of skin that can be cosmetically covered once healed. Discolouration will form at a donor site, so visible body areas are seldom used as donor sites. The healing of the donor site occurs by epithelial migration from the epithelial remnants in the dermis, such as hair follicles, sebaceous gland and sweat glands. Epithelial migration also occurs from the wound margins *[Figure 2]*.

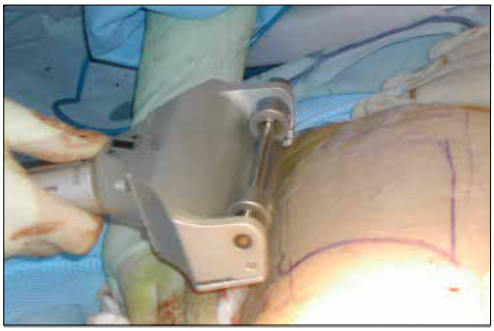

Figure 1. *Dermatome harvest of a skin graft*

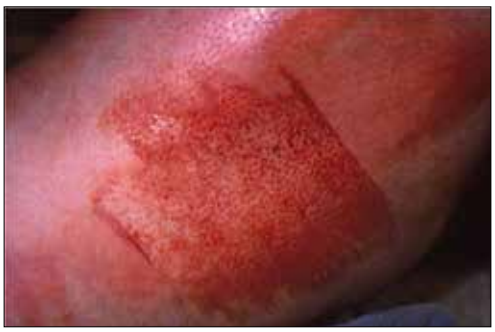

Figure 2. *Healing donor site.*

The donor site must be covered to reduce pain and facilitate healing. Donor sites are often more painful than the recipient wound due to exposed dermal nerve endings. A single-centre randomised controlled trial examined healing rates, pain, frequency of dressing changes and donor site complications between different dressings in 97 patients (Kazanavicius et al, 2017). Dressings studied were polyurethane, polyurethane form with a silicone inner lining, transparent film and gauze dressings. Donor sites covered with gauze healed in 12–21 days. Donor sites covered with the other dressings healed with 9–15 days. Donor sites dressed in film (e.g. Tegaderm™, 3M) healed the quickest. A metaanalsyis of donor sites found that those dressed with moist dressings were the least painful (Serebrakian et al, 2018).

3 Skin grafts must form their own blood supply: The harvested skin graft is completely separated from its vascular supply prior to its transplantation in the recipient site. It must form its own blood supply and, when it does, the graft is said to 'take'. Initially, the skin graft receives its nutrition and oxygen from absorption of plasma on the wound bed.

Joyce Black *is Professor, College of Nursing, University of Nebraska Medical Center, Omaha, US;*
Jonathan Black *is Assistant Professor, Department of Plastic Surgery, University of Virginia, Charlottesville, Virginia, US*

This process is called plasmatic imbibition (to imbibe or 'drink') and is analogous to diffusion. During this time, the skin graft is white and may appear somewhat oedematous. Furthermore, because nutrients diffuse more effectively over shorter distances, thinner grafts tend to survive better in this stage of graft healing. To facilitate the 'take', a fibrin network forms between the graft and the recipient bed.

At 2–5 days, vascular buds anastomose with both preexisting (stage 2) and newly formed (stage 3) vessels. Stage 2 is called inosculation ('to kiss') and stage 3 is called neovascularisation. This process is quicker for split grafts compared to full-thickness grafts due to the greater thickness requiring revascularisation. Lymphatics develop in the graft tissue at approximately 1 week after transplantation. Some graft sites will reinnervate, but most grafts have some degree of numbness. The graft often appears thickened for months and is reflective of both oedema (from essentially 'starving' for a week) and immature scar formation.

4 Consider referral for skin grafting for patients with arterial disease and diabetic foot ulceration: STSGs work well for revascularised limbs in the setting of peripheral arterial disease. The use of STSG in patients with arterial disease and foot and ankle wounds treated endovascularly was reported by Naz and colleagues (2019). Thirty-five patients with 47 wounds underwent STSG. There were 21 men and 14 women with a mean age of 64 ± 13 years. Revascularisation was required in 23 patients (25 extremities) before STSG, with balloon angioplasty for tibial artery lesions as the most common revascularisation. A complete pedal arch was defined when both the dorsalis pedis artery and at least one of the plantar arteries were patent and directly connected to one another. Split-thickness skin graft placement was performed as per the following STSG preparation protocol to achieve a granulating, clean wound bed. All patients received a minimum of two separate surgical debridements (to obtain a healthy wound bed), the first several days prior to the grafting procedure and the other on the day of STSG immediately before skin grafting. Patent pedal arch was present in eight patients; 35 patients had an absent or incomplete pedal arch. Patients with a fully patent pedal arch healed at a significantly higher rate than those with an absent or incomplete pedal arch at 1 month (62.5% vs. 17.1%, p=0.05). At 90-day follow-up, 9 of 35 (25.7%) patients with 9 of 47 (19.1%) wounds were lost to follow-up, leaving 18 of 38 (47.37%) wounds healed and 20 (52.63%) still open. Ultimately, 36 of 47 (76.60%) wounds healed and six major amputations in 6 patients were required at a mean 502 ± 342 days follow-up. It is critical to understand the need for granulation tissue in this setting as a marker for successful skin graft closure.

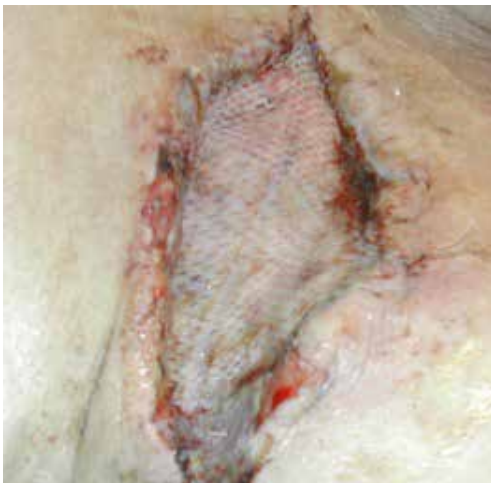

Figure 3. Skin graft showing little take (small pink area at the top has taken)

A meta-analysis on the effectiveness of STSG in treating diabetic leg and foot ulcers was conducted by Yammine and Assi (2019). Eleven studies comprising 757 patients with 759 foot/leg ulcers were included. All patients were diabetic with a mean age of 55.63 ± 4.57 years. The mean HbA_{1c} from five studies was 8.79 ± 1.0%. The primary outcome was healing rate. Secondary outcomes were time to heal, ulcer recurrence rate, ulcer transfer rate, infection rate, amputation rate, and donor site morbidities. After a mean period of more than 2 years, 85.5% of ulcers were healed over a mean time of 5.35 ± 2.25 weeks, with a recurrence rate of 4.2%, an infection rate of 4.4%, and a regrafting rate of 12.1%. Infection was the only reported donor site morbidity with a frequency of 1.74%. These outcomes are found to be noticeably superior to those reported in the literature following standard conventional care.

5 Protect the graft site from movement and oedema: Unlike flaps, which are connected to a blood supply, skin grafts lack a blood supply of their own, and must rely on the recipient wound bed for nutrients. Therefore, any accumulation of blood or plasma can lift the graft from the wound bed and compromise graft survival. Haematoma or seroma formation may occur despite meticulous haemostasis if inadequate pressure dressings are used, if the

graft is subjected to trauma, or if the patient participates in physical activity involving that region of the body, especially when the leg is lowered. Bolstered dressings or negative pressure are excellent methods to keep the graft adhered to the wound bed.

A systematic review and meta-analysis on the differences in skin grafts treated with negative pressure therapy versus conventional gauze dressings examined five cohort studies and seven RCTs including 653 patients were eligible for inclusion (Yin et al, 2018). Data were examined on rate of graft take, rate of wound infection, and the need for additional surgery. The findings indicated that patients treated with NPWT had a significantly higher rate of graft take compared to those treated with conventional therapy (P=0.00). NPWT was associated with a reduction in reoperation (P=0.00). The reduction in wound infection did not differ (P=0.20). While NPWT is often the preferred method of initial graft stabilisation, it is not always possible based on the anatomic location, wound configuration or patient situation.

6 Grafts work ('take') best when conditions of the recipient bed are best: The primary conditions relate to blood supply, cleanliness, and optimal diffusion characteristics *[Figure 3]*. Blood supply is a factor of both the regional blood supply and metabolic rate of the tissue type. Tissue with a high metabolic activity tend to have better outcomes. Muscle, which is intended to be very active, supports skin grafts nicely compared to adipose tissue, which is intended to be a low metabolic rate storage unit. Necrotic tissue by definition is not alive and, therefore, fails to support a skin graft. Infected wound beds similarly perform poorly with grafts due to infectious organising attacking the devascularised graft and taking the nutrients from the bed away from the new graft. Finally, diffusion success relates highly to the distance nutrients need to travel with greater distances being less favorable. Intervening fluid (such as serous fluid of haematoma) between the bed and graft often lead to graft failure as the diffusion distance is too large to overcome.

7 Grafts lack the durability to cover 'critical structures' such as vessels, organs, nerves, bone: While grafting works very well to cover large surface area shallow wounds, they do not carry soft tissue bulk to cover important structures. They lack the padding to cover nerves, vessels, and bone and will often break down over these structures with minimal trauma. Each of these structures also lacks a proper vascular bed to support the graft initially. This tends to lead to initial failure of grafting when these structures are involved. Due to this known problem, reconstructive surgeons often choose an alternate method of coverage (e.g. flap) to ensure durability with a source blood supply not reliant on the bed itself.

8 Protect the newly grafted skin from injury: The newly grafted skin is more fragile and more vulnerable to trauma and sun damage for several weeks after surgery. Instruct the patient to avoid exposure to the sun with clothing and hats until the skin has matured, 12–18 months post-graft.

9 Skin grafts contract as they heal: Wound contracture is more common in STSGs than in FTSGs, and it can lead to cosmetic and functional problems. The amount of wound contracture after grafting (referred to as secondary contracture) relates to the amount of dermis present in the graft. Thicker dermis present in full-thickness grafts provides a greater amount of stimulus against contact inhibition at the wound perimeter. The concept is that the wound perimeter will 'replace' the missing tissue with contraction relative to the amount of tissue replaced by the graft. The more graft thickness given to the wound, the less the wound needs to replace.

Grafts themselves contract in a centripetal fashion once harvested due to the movement of unopposed elastic fibres (referred to as primary contraction) and occurs more in grafts with greater amounts of elastin (i.e. full thickness grafts). This may also occur in the graft, as well as in the recipient bed underlying the graft tissue. If significant functional impairment occurs secondary to graft contracture, surgical revision may be indicated.

10 Moisturise the skin graft daily: Almost all skin grafts are capable of sweating in response to stimulation of the nerves that ingrow from the recipient site. STSGs often have deficient function of sebaceous glands and therefore should be lubricated for at least three months. Teach the patient to moisturise the skin graft and donor site at least daily (once it is 'healed') with a mild, non-scented moisturiser to keep it from drying out.

Conclusion

Skin grafting is a common method to close

superficial wounds. Due to the fact that the skin graft does not contain its own blood supply, it must be protected from oedema for the first few days until a take occurs. Contracture of the graft will occur and can lead to distortion of nearby tissues and may require surgical revision. The new skin graft should be shielded from sunlight and moisturised daily. WINT

References

Cuomo R, Grimaldi L, Brandi et al (2017) Skin graft donor site: a procedure for a faster healing. *Acta Biomed* 8(3): 310–4

Humrich M, Goepel L, Gutknecht M et al (2018) Health-related quality of life and patient burden in patients with split-thickness skin graft donor site wounds. *Int Wound J* 15(2): 266–73

Kazanavicius M, Cepas A, Kolaityte et al (2017) The use of modern dressings in managing split-thickness skin graft donor sites: a single-centre randomized controlled trial. *J Wound Care* 26(6): 281–91

Naz I, Walters ET, Janhofer DE et al (2019) Outcomes of Split-thickness Skin Grafting for Foot and Ankle Wounds in Patients with Peripheral Arterial Disease. *Wounds* 31(11): 272–8

Serebrakian A, Pickrell BB, Varon DE et al (2018) Meta-analysis and systematic review of skin graft donor-site dressings with future guidelines. *Plast Reconstr Surg Global Open* 6(9): e1928

Yammine K, Assi C (2019) Meta-Analysis of the Outcomes of Split-Thickness Skin Graft on Diabetic Leg and Foot Ulcers. *Int J Low Extrem Wounds* 18(1): 23–30

Yin Y, Zhang R, Li S et al (2018) Negative-pressure therapy versus conventional therapy on split-thickness skin graft: a systematic review and meta-analysis. *Int J Surg* 50: 43–8