Tidsskriftet Tidsskrift for Den norske legeforening

Skin grafting

CLINICAL REVIEW

AYYAD ZARTASHT KHAN

ayykha@ous-hf.no
Department of Plastic and Reconstructive Surgery
Oslo University Hospital
Author contribution: idea, design, literature search, preparation of the manuscript, approval of the version of the manuscript submitted.
Ayyad Zartasht Khan PhD, specialty registrar in the Department of Plastic and Reconstructive Surgery at Oslo University Hospital until 31.1.2022.
The author has completed the ICMJE form and declares no conflicts of interest.

TOR PAASKE UTHEIM

Department of Plastic and Reconstructive Surgery
Oslo University Hospital
and
Department of Medical Biochemistry
Oslo University Hospital
Author contribution: idea, revision of the manuscript, approval of the version of the manuscript submitted.
Tor Paaske Utheim, specialist in ophthalmology and professor.
The author has completed the ICMJE form and declares no conflicts of interest.

MARTIN BYHOLT

Department of Plastic Surgery
Østfold Hospital
Author contribution: revision of the manuscript, approval of the version of the manuscript submitted.
Martin Byholt, specialist in plastic surgery, senior consultant and head of section.

The author has completed the ICMJE form and declares no conflicts of interest.

TAMMY FIABEMA

Department of Plastic Surgery
Telemark Hospital, Skien
Author contribution: revision of the manuscript, approval of the version of the manuscript submitted.
Tammy Fiabema, specialist in plastic surgery and senior medical consultant.
The author has completed the ICMJE form and declares no conflicts of interest.

HANS CHRISTIAN SYLVESTER-JENSEN

Department of Plastic, Hand and Reconstructive Surgery and National Burns Centre
Haukeland University Hospital
Author contribution: revision of the manuscript, approval of the version of the manuscript submitted.
Hans Christian Sylvester-Jensen, specialist in plastic surgery, senior consultant and head of department.
The author has completed the ICMJE form and declares no conflicts of interest.

KIM ALEXANDER TØNSETH

Department of Plastic and Reconstructive Surgery
Oslo University Hospital
and
Institute of Clinical Medicine
University of Oslo
Author contribution: idea, revision of the manuscript, approval of the version of the manuscript submitted.
Kim Alexander Tønseth, specialist in plastic surgery, head of department and professor.
The author has completed the ICMJE form and declares no conflicts of interest.

Skin grafting involves covering an area of missing skin with healthy skin tissue harvested from another part of the body. The aim of this clinical overview is to give a short introduction to the procedure.

Burns, scalds, trauma and cancer surgery can result in major defects in the skin that must be covered and reconstructed. The reconstructive ladder is a well-known principle within reconstructive surgery that arranges the various treatment strategies for skin defects in order of increasing complexity (Figure 1) (1). The idea behind this principle is to choose the most efficient treatment option, i.e. the best possible result with the simplest procedure. Examples of strategies are healing by secondary intention, vacuum-assisted closure therapy, primary closure, skin grafting, tissue expansion and flap surgery. Primary closure (2), tissue expansion (3) and flap surgery (4, 5) have been discussed in the Journal of the Norwegian Medical Association before. This clinical overview only deals with skin grafting. The article is based on plastic surgery textbooks, selected journal articles and clinical experience.

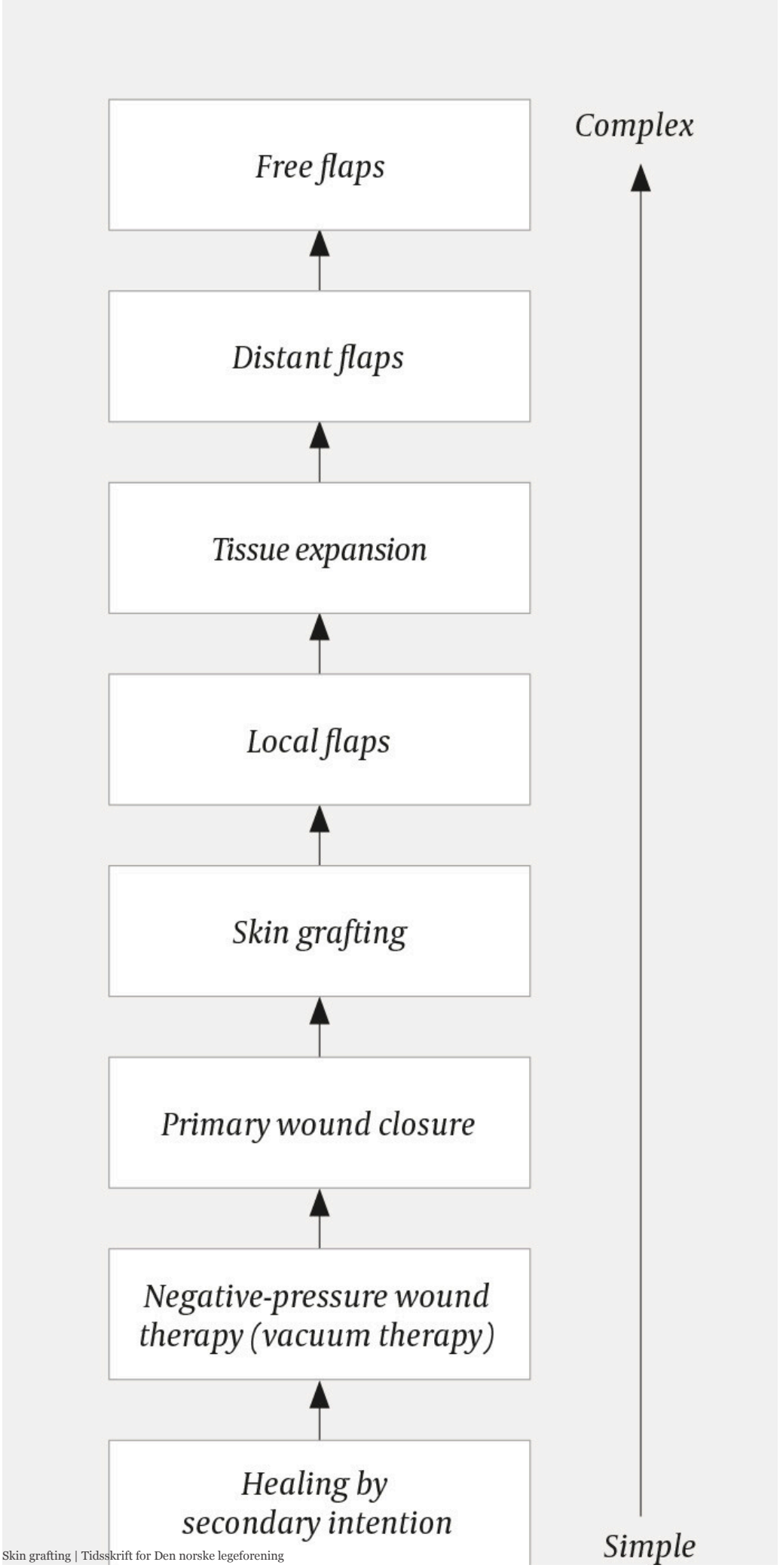
Free flaps
Distant flaps
Tissue expansion
Local flaps
Skin grafting
Primary wound closure
Negative-pressure wound therapy (vacuum therapy)
Healing by secondary intention
Complex
Simple

Figure 1 The reconstructive ladder is a principle within reconstructive surgery (1) which aims to achieve the best possible result with the least complex treatment technique. The techniques increase in complexity as you ascend the ladder. Healing by secondary intention, meaning that a wound defect fills with granulation tissue that grows from the wound bed, is the first step of the ladder. The next steps are vacuum therapy, direct wound closure (suturing) and skin grafting. Local flaps involve the transposition of tissue to a tissue defect in close proximity. In tissue expansion, a balloon is used to gradually expand an area of skin so that it can be used for reconstruction. Distant flaps involve moving tissue from one part of the body to another. At the top of the ladder come free flaps, in which the blood supply to the donor tissue is cut before the flap is moved to the recipient site, and the blood supply is restored with anastomoses.

Full-thickness skin grafting

The skin is traditionally divided into three layers: epidermis, dermis and hypodermis/subcutis. Based on this, skin grafts can be classified as either full-thickness or split-thickness (Figure 2) (6). Full-thickness skin grafts consist of both the epidermis and dermis. This type of graft is typically used in the reconstruction of tissue defects of the face and hands, but in exceptional cases also in other parts of the body in patients with poor skin quality, or in instances where harvesting of split-thickness skin may cause wound healing problems at the donor surface. Traditionally, full-thickness skin grafts are harvested with a fusiform incision with primary closure of the donor site, which limits the amount of skin that can be harvested with this technique. Common donor sites for full-thickness skin grafts are areas of the body that often have excess skin: inner arm and thigh, supraclavicular area, groin, lower abdomen, preauricular and postauricular areas, or eyelid.

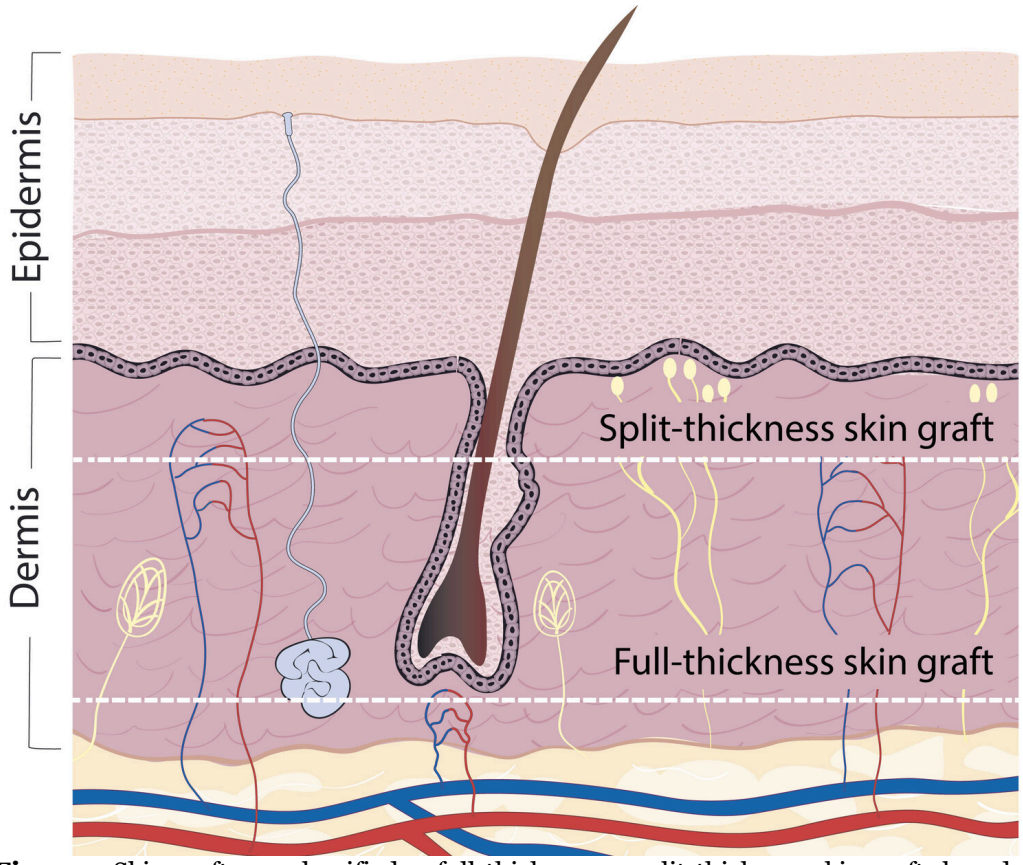

Figure 2 Skin grafts are classified as full-thickness or split-thickness skin grafts based on the thickness of the skin graft. Illustration: Illumedic

Split-thickness skin grafting

Split-thickness skin grafts consist of the epidermis and a portion of the dermis and are harvested with an instrument called a dermatome (Figure 3a). The grafts are usually 0.15–0.30 mm thick. By passing the graft through a device that makes multiple cuts in the graft (*meshing*) (Figure 3b), the split-thickness skin graft can be stretched to cover an area larger than the original donor tissue (Figure 3c). Hence, a larger wound surface area can be covered with split-thickness skin grafts than with full-thickness skin grafts. The usual mesh ratio for split-thickness skin is 1:1.5, but it is possible to use mesh plates that make the graft up to nine times larger. Besides expanding the surface area of the donor tissue, the cuts also allow drainage of wound fluid, which is important for graft take and prevention of complications. The donor site is covered perioperatively with sterile pads soaked in adrenaline and local anaesthetic diluted in saline. Postoperative wound care of the donor site varies, but generally includes the use of Vaseline gauze and moist dressings, various types of foam dressings and dressings containing silver. The donor site will normally heal by secondary intention within about two weeks, depending on the size of the graft harvested. Both full-thickness and split-thickness skin grafts are fixed to healthy skin margins with staples or rapidly absorbable sutures (Figure 3d).

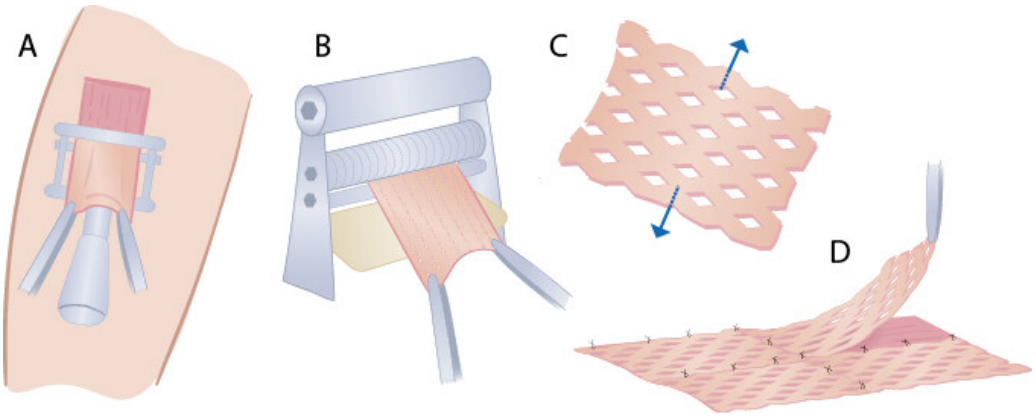

Figure 3 The figure shows the steps in split-thickness skin grafting with skin harvesting from a donor site (A), meshing of the graft (B and C) and graft fixation (D). Illustration: Illumedic

Perioperative considerations

Prior to grafting, the surgeon performs a careful assessment of the clinical indication, including assessment of the tissue defect and wound bed, donor site and alternatives to skin grafting. In terms of the wound bed, a graft will be dependent on the underlying blood circulation to enable capillary in-growth and adherence. Therefore, skin grafting directly over bone, cartilage and tendons is generally avoided. Nevertheless, skin grafting on fatty tissue, which is also poorly perfused, is considered in burns, but with somewhat poorer graft take as a result. Chronic wounds with poor blood supply would also be unsuitable for direct skin grafting. Moreover, microbiological contamination of the wound bed is undesirable, and bacterial colonisation is common in burns (7). Efforts are made to decontaminate the wound bed prior to covering with the skin graft. Skin grafts involving less than about 1 % of total body surface area are generally performed under local anaesthesia. Larger procedures, for example involving burns, are usually performed under general anaesthesia.

Postoperative conditions

In the first few hours following grafting, the graft will not have any blood supply and will receive nutrition through passive diffusion from the wound bed. Revascularisation will then commence, typically within 24 to 48 hours after grafting (8). For optimal graft take, movement must be minimised between the graft and the wound bed for the first five to ten postoperative days. A range of measures can be taken for this purpose, for example spraying the dermal side of the graft with tissue adhesive, suturing or stapling the dressing directly over the graft (called a tie-over) and use of negative-pressure dressings that draw out fluid while at the same time pressing the graft and wound bed together (9). The first dressing change, when the dressing that is fixed over the graft by sutures or staples is removed, normally takes place five to seven days

postoperatively, by a surgeon or the treatment facility where the graft was performed. Removal of the tie-over is performed at an outpatient clinic or on the ward unless other factors (e.g. pain) necessitate general anaesthesia.

In procedures involving hair follicles or sweat glands, hair growth and sweat secretion can be expected within two to three months. Moisturising cream is recommended to avoid skin dryness, particularly in the period before secretory function has resumed. As with all scars, use of sunscreen is also recommended during sun exposure, both on the graft area and the donor surface (10). Recovery of sensory function often takes longer, typically a year. However, many people find that skin sensitivity never becomes 'fully normal'.

Complications

Successful skin grafting depends on multiple factors. Comorbidities increasing the risk of complications include heart failure, diabetes, peripheral vascular disease and poor nutritional status (1). Smoking is associated with graft necrosis (10). Factors related to the wound itself, such as circulation, microbiological contamination and appropriate dressing, are also crucial for graft take (11). Blood and other fluid accumulating between the wound bed and the overlying graft may form a haematoma or seroma, which prevents graft take. Grafting can also be complicated by infection.

Preventative measures such as optimal cleansing of the wound bed, meshing and incisions in the graft, vacuum-assisted therapy and appropriate dressing can prevent the aforementioned complications (12). Furthermore, preoperative injection of adrenaline solution into the subdermal fatty layer can reduce donor site bleeding associated with graft harvesting (13). Scar hypertrophy and contraction of the graft are other complications that occasionally occur.

Alternatives to skin grafting

In case of major injury or poor donor skin availability, commercial skin substitutes or cultured cells can be used as alternatives to skin grafting or as temporary covering prior to grafting at a later date. This applies to highly specific cases and will generally be performed in specialist departments. The interested reader is referred to a review by Debels et al. on this subject (14). Another strategy that has attracted a great deal of interest in recent years is 3D-printing of skin products (15). The advantage is that there is no need to shave donor tissue from the patient. The 'ink' in 3D-bioprinting may be a mixture of growth factors, cultured cells and intercellular substance which can be deposited directly into the tissue defect in a single layer, or in different layers with each layer consisting of different components. It is hoped that further research and development can improve these techniques.

Conclusion

There is long clinical experience with skin grafting, and it is carried out in most (plastic) surgery departments in Norway. Thorough perioperative assessments and optimisation of conditions to ensure good healing following grafting are crucial for a good result. The main complications are poor graft take, seroma and infection. In the future, it is hoped that dermal substitutes and 3D-bioprinting will contribute to continued development of skin grafting techniques.

The article has been peer-reviewed.

REFERENCES

1. Janis JE. Essentials of plastic surgery. 2. utg. St. Louis, MI: CRC Press, 2014.

2. Berg-Knudsen TB, Ingvaldsen CA, Mørk G et al. Eksisjon av hudlesjoner. Tidsskr Nor Legeforen 2020; 140: 1034–7.

3. Kalaaji A, Bruheim M. Vevsekspansjon for rekonstruksjon ved huddefekter. Tidsskr Nor Legeforen 2008; 128: 1673–6. [PubMed]

4. Weum S, de Weerd L, Klein S et al. Behandling av bløtdelsdefekter med perforatorlapper. Tidsskr Nor Legeforen 2008; 128: 313–5. [PubMed]

5. Schive Ø, Frich L. Rekonstruksjon av sårdefekter i perineum. Tidsskr Nor Legeforen 2021; 141. doi: 10.4045/tidsskr.21.0161. [PubMed][CrossRef]

6. Yousef H, Alhajj M, Sharma S. Anatomy, Skin (Integument), Epidermis. Treasure Island, FL: StatPearls Publishing, 2021.

7. Guttormsen AB, Onarheim H, Thorsen J et al. Behandling av alvorlige brannskader. Tidsskr Nor Legeforen 2010; 130: 1236–41. [PubMed] [CrossRef]

8. Lindenblatt N, Calcagni M, Contaldo C et al. A new model for studying the revascularization of skin grafts in vivo: the role of angiogenesis. Plast Reconstr Surg 2008; 122: 1669–80. [PubMed][CrossRef]

9. Scherer LA, Shiver S, Chang M et al. The vacuum assisted closure device: a method of securing skin grafts and improving graft survival. Arch Surg 2002; 137: 930–3, discussion 933 - 4. [PubMed][CrossRef]

10. Goldminz D, Bennett RG. Cigarette smoking and flap and full-thickness graft necrosis. Arch Dermatol 1991; 127: 1012–5. [PubMed][CrossRef]

11. Seyhan T. Split-thickness skin grafts. I: Spear M, red. Skin Grafts – Indications, Applications and Current Research. London: IntechOpen, 2011.

12. Donegan RJ, Schmidt BM, Blume PA. An overview of factors maximizing successful split-thickness skin grafting in diabetic wounds. Diabet Foot Ankle 2014; 5: 24769. [CrossRef]

13. Robertson RD, Bond P, Wallace B et al. The tumescent technique to significantly reduce blood loss during burn surgery. Burns 2001; 27: 835–8. [PubMed][CrossRef]

14. Debels H, Hamdi M, Abberton K et al. Dermal matrices and bioengineered skin substitutes: a critical review of current options. Plast Reconstr Surg Glob Open 2015; 3: e284. [PubMed][CrossRef]

15. Ishack S, Lipner SR. A Review of 3-Dimensional Skin Bioprinting Techniques: Applications, Approaches, and Trends. Dermatol Surg 2020; 46: 1500–5. [PubMed][CrossRef]

Publisert: 30 May 2022. Tidsskr Nor Legeforen. DOI: 10.4045/tidsskr.21.0671
Received 22.9.2021, first revision submitted 20.12.2021, accepted 3.2.2022.