Surgical Advances in Wound Care: A Canadian Perspective

BY Kenneth N. Dolynchuk

The practice of wound care has evolved over the past decade to include technologies to restore the integrity of wounds by means of surgical and biologically active dressings. The types of technologies vary in their applications but impart incredible versatility to the handling of difficult-to-heal wounds.

This paper will include examples of living skin equivalents (LSEs) technology and negative pressure therapy. The use of biologically active dressings in combination with the negative pressure therapy and surgical debridement will be shown to improve the take of skin grafts in radiation ulcer patients. Laser ablation of hypertrophic scars using Erbium YAG laser will be presented as well as some future surgical directions for local wound infection control.

Living Skin Equivalents (LSEs)

The currently available biologically active dressings share in their ability to provide a composite of human fibroblasts in a collagen matrix. The outer layer of one type is silicone sheeting, which is ultimately removed prior to skin grafting over top. Another type can also be skin grafted over top, but it is usually open until such time as the wound bed is prepared adequately. The use of this latter type has been shown to be of benefit in diabetic foot sores and in venous leg ulcers in clinical trials. The use of the former is reserved mainly for burn wounds.

The benefit of LSEs relates to the fact that the cytokine pathway and/or cellular responses are abnormal in hard-to-heal wounds. Biological dressings are active in that they increase the number of responsive cells in the wound, shifting the rate of healing toward normal. The structure of LSEs is uniquely bioengineered using human neonatal fibroblasts in a polylactic acid matrix. Advantages compared with alternative management include ready availability without donor site morbidity, lack of allogeneic cells (Langerhans, lymphocytes, etc.), rigorous safety testing and outpatient orientation. The efficiency of one particular type of LSEs showed a 50 per cent vs. 32 per cent healing rate at the 12-week end point in chronic leg ulcers. Disadvantages are the incident cost of the dressing (e.g., $650 CDN), a limited shelf life and the fact that reimbursement is still an issue.

Negative Pressure Therapy

Negative pressure therapy was introduced in 1977. It is indicated for incisions, myocutaneous flaps, skin grafts and chronic wounds. However, it is contraindicated in necrotic wounds with eschar, malignant wounds and untreated osteomyelitis. Its mechanism of action includes removal of proinflammatory exudates and fibrin, production of wound contraction and formation of granulation tissue.

In one case a 58-year-old female in renal failure and coronary artery disease presented one week post-CABG. She suffered complete dehiscence of her left thigh saphenous vein donor site, due to heavy colonization with *Staphylococcus aureus*. She was considered unfit to return to the operating room for delayed reclosure and was started on chlorhexidine compresses O.D. for 48 hours prior to beginning negative pressure

Kenneth N. Dolynchuk, MD, PhD, FRCSC, FACS, is at the University of Manitoba, Department of Surgery, Section of Plastic Surgery.

therapy. At six weeks she was nearly healed and able to leave hospital.

The second case is that of a 63-year-old female with a two-year history of an ankle radiation ulcer post squamous cell carcinoma excision and graft. She failed to heal after radiation despite optimal wound care. Osteomyelitis was ruled out with biopsy taken to confirm lack of recurrence. The wound bed was prepared with an enzymatic debriding agent and LSE applications three times over 12 weeks (Figure 1). Her eventual status was that of steady improvement and unstable epithelium on a dense fibrotic base. She still hasn't healed but is off the negative pressure therapy and being treated with conventional dressings while continuing to stabilize.

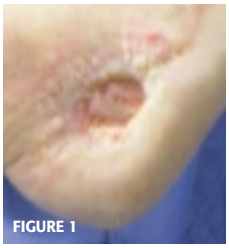
FIGURE 1

In a third case negative pressure therapy was combined with LSEs. The female patient had a severe radiation ulcer on the nape of the right neck after 12,000 rads were given to treat lymphoma and a secondary sarcoma. The area was debrided surgically and a sheet of LSEs applied under a negative pressure therapy dressing that was changed every week. She remained stable and healed off negative pressure therapy. However, during a subsequent winter cruise she developed a recurrence. Further surgery after a trial of a new dressing technology is being considered for the recurrent ulcer. This case illustrates the benefit of combining biological skin substitutes and negative pressure therapy. Although the particular brand of LSEs used in this case is no longer available in Canada, the use of split thickness skin grafts may be used in such a case, with similar results expected.

Scar Reconstruction

Erbium YAG laser preceded other forms of laser resurfacing but was not commonly employed until recently. Unlike CO_2 laser thermal denaturation of deep dermal structures, it is limited to 2.5–5.0 μ depth. Therefore, the risk of hypertrophic scarring and redness postoperatively is reduced. Patients may first require scar revision to reduce the size of the scar, which may have stretched or undergone hypertrophy, which, in turn, produced an excessive scar matrix. The subsequent scar is usually improved by surgical revision utilizing lateral flap or Z-plasty techniques to reduce the appearance of the scar. Further revision is then carried out three months later using ablative techniques such as dermabrasion or Er YAG laser. If redness persists beyond six weeks, Nd YAG laser treatment can be used to reduce these problems as well.

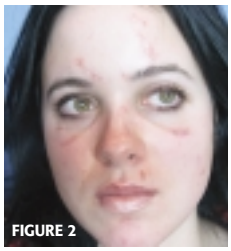
FIGURE 2

As seen in the patient in Figure 2, red ropy scars have persisted after one year. She underwent staged scar revision and laser therapy with the ultimate results being quite satisfactory. In Figure 3 the last surgical revision is seen above the left brow. This will require Nd YAG therapy in four to six weeks.


FIGURE 3

Future Therapy

Prevention of surgical site infection (SSI) is the ultimate goal of surgeons globally. The use of antimicrobial impregnated suture is one way in which to achieve this.

Innovative technology for prevention of scar formation will also be available soon. In the near future a cream that prevents hypertrophic scar formation will be undergoing final clinical trials, and the need for revision surgery as described above may become less common. The ultimate goal would also be to eliminate other forms of pathological scarring, such as keloid formation. This is under investigation as well.

Conclusions

As caregivers in wound care, we in Canada stand at the dawn of a new era in terms of providing the best and most advanced treatment to our patients. The techniques exemplified are surgical in their scope but marry well with the overall care of patients. It is hoped that the newer technologies will ultimately aid in treatment of hard-to-heal ulcers and prevent pathological wounds and scars in all patients.