Journal of Plastic, Reconstructive & Aesthetic Surgery (2008) **61**, 1507—1511

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Treatment with vacuum-assisted closure and cryo-preserved homologous de-epidermalised dermis of complex traumas to the lower limbs with loss of substance, and bones and tendons exposure

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Received 21 March 2006; accepted 27 September 2007

KEYWORDS
VAC therapy;
Lower limbs injuries;
DED;
Traumatic wound

Summary Lower-limb injuries with loss of tissue and exposure of bones and tendons are an increasing problem. The condition of the wound locally and the patient in general does not always allow immediate and adequate coverage of the structures exposed by the trauma. Therefore, new therapeutic solutions are needed. A reduction in the time that bones and tendons are exposed is essential to achieve complete healing of bone fractures, with reduced risks of infection and less disabling outcomes.

The effectiveness of vacuum-assisted closure (VAC) therapy in supporting wound healing and of cryopreserved homologous de-epidermalised dermis (DED) in providing an effective template for re-epithelialisation has been previously reported. We carried out a study to evaluate the effectiveness of the synergistic and combined use of the two methodologies. Eighteen patients with traumatic loss of tissue in the lower limbs, involving exposure of bone and tendon structures, were enrolled in the study. All participants had local, general contraindications to first-instance reconstructions, or both.

All patients received a combination of VAC therapy and DED implants. Granulation tissue was obtained in all wounds, with complete coverage of exposed structures. No infections were detected in the cohort, and all patients were prepared for further necessary reconstructive treatments. In our experience, the combination of VAC therapy and DED could, in selected

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1748-6815/$ - see front matter
doi:10.1016/j.bjps.2007.09.036

cases, constitute an effective treatment for complex lower limb traumatic injuries with bone and tendon exposure.

Higher life expectancy and improvements in diagnostic and therapeutic possibilities have led to an increase in chronic pathologies, pressure ulcers, post-traumatic injuries, workplace and road accidents, and burns.[1] Within a multi-disciplinary treatment plan, the role of the plastic surgeon is to prepare the wound for reconstructive plastic surgery and induce the skin lesion to heal.

Many problems arise from treating injuries with loss of substance and exposure of bones and tendons, and many are difficult to resolve. The severity of injuries in emergencies is linked to the amount of bone damage, to the extent of soft tissue loss, to the state of neuro-vascular and muscular function, and to the presence of compartmental syndrome. Moreover, reconstructive possibilities are linked to, and are frequently restricted by, circulatory conditions that often entail pre-existing pathologies or traumatic lesions, the limited possibility for tissue mobilisation and the presence of orthopaedic devices.[2–5] Free, local flaps, or both, are often necessary to treat these patients, although in some cases it is impossible for them to undergo reconstructive plastic surgery in the first instance. Other methods must therefore be found to treat these patients quickly. An essential prerequisite for the sound consolidation of bone fractures (when present) is to reduce the time that bone and tendon structures are exposed, which will lower the risk of infection and reduce the likelihood of a disabling outcome. We undertook a study to evaluate the effectiveness of the synergistic and combined use of the VAC therapy and cryopreserved homologous DED at the Plastic Surgery Unit at Siena University from January 2004 until June 2005. This was based on available research on, and positive personal experience of, the effectiveness of using VAC therapy to promote the formation of granulation tissue,[6,7] and cryopreserved homologous DED to create a sound substratum for reconstruction of the epidermis[8–12] (thus guaranteeing that the exposed bone and tendon structures are covered and that their vitality is safeguarded).

Materials and methods

Eighteen patients were enrolled into the protocol (aged between 45 and 78 years, average age 56 years). All had post-traumatic injuries in the lower limbs, characterised by the loss of soft tissue as well as bone and tendon exposure. All the patients' local, general problems, or both, impeded immediate and adequate coverage of the bone and tendons structures exposed by the trauma with plastic and reconstructive techniques (Table 1). In particular, examination of the vascular conditions showed the presence of a serious peripheral arteriopathy in 12 patients, four of whom were also afflicted with decompensation linked with type II diabetes mellitus. In six patients, the trauma had extensively affected the peripheral vascular axes, and two patients already had signs of chronic compromise. All the patients underwent orthopaedic treatment. There was recourse to bone synthesis with an external fixative in 11 cases; endomedullar synthesis was carried out in five cases; bone immobilisation was obtained by applying plates and screws in one case, and a plaster device was made for one patient. Upon entering the ward, all the patients' wounds were surgically debrided and a sample of biological material was therapy was applied at 125 mmhg under continual negative pressure for 3 days for optimal preparation of the wound bed. All the patients then underwent skin grafting with cryopreserved DED from the skin bank in order to cover bone and tendon exposure, followed by VAC. The polyurethane foam was applied by interposing a non-adherent vaseline gauze dressing, and continuous sub-atmospheric pressure of 125 mm/Hg was applied. The medication was replaced every 72 h, and the quality and quantity of the exudate were checked. At the same time, a sample was taken from the wound for culture tests. Eight patients were treated in day hospital care, whereas four other patients were discharged on the fifth day after surgery and were subsequently treated in the Outpatient department. The remaining six patients stayed in hospital until treatment had been completed.

Results

Recruitment of granulation tissue was good in all cases, which contributed to covering the exposed bone and tendon structures, starting from the edges of the wound and efficiently colonising the grafted DED. Satisfactory prevention of necrosis in bony and tendinous exposed tissues was achieved by the use of DED. The integrated treatment of DED and VAC therapy made it possible to treat the most central areas of the wounds with granulation tissue, as well as the bone and tendon structures, which are at a disadvantage from a trophic point of view. VAC therapy, started at the same time as DED treatment, lasted between 9 and 60 days (21 days on average), and was applied for the amount of time required to obtain suitable local conditions for reconstructive plastic surgery. Operation possibilities were fine-tuned according to the conditions obtained after the patients had been treated. In one case (a patient with serious artheriopathy with a plaster device), partial regression of the wound occurred on day 28 after initial coverage of the bone exposure. This was due to deterioration of the vascular conditions. However, it was still possible to complete reconstructive surgery using local flaps and skin graft, based on the results obtained by the combined treatment of DED and VAC therapy. In another case, a seriously disabling outcome on a functional level resulting from the injury, led the patient to request an amputation. However, the results obtained by using the two combined methods of DED and VAC therapy allowed us to recuperate sound granulation tissue and carry out amputation of the leg