

# NEGATIVE PRESSURE IN THE EARLY MOBILISATION OF LOWER LIMB AMPUTEES

The majority (72%) of lower limb amputations performed in the UK occur as a result of peripheral arterial disease (National Amputee Statistical Database [NASDAB], 2007). Studies looking at the risk factors associated with peripheral arterial disease have indicated that incidence is more common in men, increases with age and is closely associated with smoking (Ouriel, 2001). Secondary outcomes also show that diabetes is a significant risk factor, with 54% of dysvascular amputees having diabetes (NASDAB, 2007).

## BACKGROUND

Wound healing in the first instance is by primary intention, however, complications such as infection, tissue necrosis and oedema often occur following lower limb amputation due to multiple co-morbidities associated with peripheral arterial disease, diabetes and renal failure (Harker, 2006; Myers, 2008). Wound healing can also be compromised by increased tissue friability associated with age and reduced tissue oxygenation from smoking (Lind et al, 1991; Sorensen et al, 2003).

Achieving mobilisation following amputation is an important goal for patients. Transtibial amputees are acknowledged to have better functional outcomes than transfemoral amputees (Houghton et al, 1992; Davies and Datta, 2003; Nehler et al 2003). Preservation of the knee joint reduces energy requirements for mobilisation and improves proprioception, which results in a more desirable patient outcome (Waters et al, 1976; Van Nierkerk et al, 2001).

Comfort, ease of use and cosmetic appearance are also fundamental considerations for the patient when using a prosthesis. Relevant literature also

suggests that undertaking rehabilitation soon after surgery enhances prosthetic rehabilitation (Friedmann, 1990; Munin et al, 2001).

Traditionally, if a transtibial stump wound fails to heal by primary intention, conventional dressings are applied and rehabilitation in terms of mobilisation is not pursued. The patient may be inactive for many weeks until wound healing is achieved, by which time the patient is often demoralised and has developed joint contractures making mobilisation on a prosthesis difficult (Van Ross et al, 2009).

In instances of complete wound dehiscence, the patient is often referred back to the vascular surgeons for revision surgery.

## Clinical Trial

Van Ross et al (2009) recruited 62 patients to a prospective clinical trial, which investigated early mobilisation in dysvascular amputees with unhealed transtibial stumps. The trial involved patients walking initially on a pneumatic post-amputation mobility (PPAM) aid for three to six weeks, following which they were measured for and fitted with a primary prosthesis.

All patients were supplied with a stump compression sock. Tissue oxygenation (TcPO<sub>2</sub>) was measured at the distal site of the stump when the patients were recruited to the trial and repeated six weeks later.

Wounds were reviewed on a weekly basis at least and were dressed as per local protocol. Necrotic tissue was removed using sharp debridement and antibiotics were only prescribed where clinical signs of infection were apparent.

Some 74% of the patients taking part in the trial achieved full wound

## ‘Achieving mobilisation following amputation is an important goal for patients’

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healing while continuing prosthetic rehabilitation. Tissue oxygenation levels improved significantly with these patients. No adverse effects to the stump or the health of the patient were recorded. Of the remaining 26% participants, 10% withdrew from the trial due to worsening medical conditions, 8% died before completion of the trial (although they were showing signs of wound healing) and a further 8% failed to heal.

Non-wound healing was associated with patients who continued to smoke and tissue oxygenation levels failed to improve in these patients.

The study also recognised that patients who are mobilised on unhealed wounds require close monitoring and that input from a specialised multi-disciplinary team is essential.

Following the success of the trial, early mobilisation has become an established protocol for patients who undergo amputation at hospitals in central and south Manchester and also those referred into the Manchester Disablement Services Centre (DSC) from the surrounding region as these areas all have dedicated input from a specialist team.

Patients with unhealed transtibial amputation wounds who are assessed as suitable candidates for prosthetic rehabilitation and are keen to walk are given the option to continue mobilisation.

As mobilising on unhealed wounds is not standard practice nationally, patients are given an information sheet explaining the benefits of mobilisation.

They are asked to sign a consent form to ensure that they are aware that their wound will be closely monitored by the specialist team and that the team would take the decision to terminate mobilisation should any deterioration to the wound occur.

## NEGATIVE PRESSURE WOUND THERAPY

The use of compression and early mobilisation aids on dehisced stump

wounds often produces large volumes of wound exudate. This means that the dressing selected, whether conventional or otherwise, needs to be able to handle increased amounts of exudate without causing maceration to the periwound skin. The dressing also needs to be conformable to the stump and comfortable for the patient (Weaver and Crawford, 2007).

One technology that is used to manage wounds healing by secondary intention is negative pressure wound therapy (NPWT). NPWT promotes healing by providing negative pressure at the wound site, thus lowering oxygen tension, removing wound exudate and stimulating angiogenesis (Banwell and Musgrave, 2004). Successful use of NPWT in primary amputation has been demonstrated by Armstrong and Lavery (2005) in the management of the diabetic foot.

Armstrong and Lavery highlight that lower extremity wounds in patients with diabetes are often complex and challenging to heal. Their RCT compared wound healing using NPWT against standard moist wound healing. The patients in the NPWT group showed a higher proportion of healed wounds and faster healing rates.

## CASE REPORTS

Three case reports are presented, focusing on patients with dehisced transtibial stump wounds who wished to continue prosthetic rehabilitation and were treated with NPWT. In each case, a GranuFoam™ dressing (KCI Medical) was applied to the wound bed and a bridge dressing was also applied to the lateral aspect to allow for the use of early walking aids, casting and prosthetic fitment (*Figure 1*). Continuous negative pressure was applied at -125mmHg and dressings were changed three times a week.

### Case report one

Mrs A is a 68-year-old woman who was admitted to hospital with multiple non-healing neuroischaemic ulcers to her left foot. Her medical history included type 2 diabetes — which was treated with insulin — hypertension, hypercholesterolemia, asthma, a mitral valve replacement and peripheral arterial disease.

## References

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Figure 1: Stump wound with NPWT dressing in situ.



Figure 2: Dehiscent wound with necrosis evident to posterior flap.



Figure 3: Wound showing largely granulation tissue, with some areas of remaining slough.



Figure 4: Healed wound.



Figure 5: Dehiscent wound following fall.



Figure 6: Healed wound.

Initially, Mrs A had an angioplasty, followed by a left popliteal-pedal bypass graft. Failure of these procedures to improve the arterial inflow to the foot resulted in a left transtibial amputation.

Following removal of sutures, the wound dehisced across the suture line. There was extensive necrosis evident to the posterior flap (Figure 2). Mrs A was keen to continue rehabilitation despite an open wound. She underwent a transcutaneous partial oxygen pressure (TcPO<sub>2</sub>) test with a result of 53mmHg and consented to the Early Mobilisation Protocol. Patients are given an information sheet explaining the benefits of mobilisation. The Early Mobilisation Protocol, which follows the success of the clinical trial, is available to patients with unhealed transtibial amputation stumps who are keen to mobilise and are then given the option to continue with rehabilitation.

TcPO<sub>2</sub> is a non-invasive way of quantifying skin oxygenation and has been used to predict wound healing. A result of greater than 30mmHg has been shown to be associated with successful wound healing (Christensen and Klarke,

1986). The wound was initially treated with a medical grade honey ointment to soften the necrotic tissue, which was subsequently removed using sharp debridement. Once the majority of the devitalised tissue had been removed, NPWT was commenced (Figure 3).

#### Outcome

NPWT continued for four weeks, during which time the wound reduced in size. No clinical signs of infection were noted and granulation tissue was evident across the wound bed with the migration of epithelial cells. Mrs A was cast for a primary prosthesis and was able to continue rehabilitation without any detrimental impact on the wound. Full wound healing was achieved following discharge and Mrs A was able to mobilise indoors with her prosthesis and a walking aid (Figure 4).

#### Case report two

Mrs B is a 68-year-old woman who presented with acute ischaemia of her right foot due to an embolus. She had a previous history of hypertension, deep venous thrombosis and pulmonary embolus. Thrombolysis was attempted, followed by a femoropopliteal

#### References

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Figure 7: Large dehiscenced stump wound.



Figure 8: Granulating wound.



Figure 9: Healed wound.

bypass graft. Revascularisation was unsuccessful however, therefore, a transtibial amputation was performed. Following the removal of sutures, the wound appeared to be healed and the patient was mobilising on an early walking aid during therapy sessions.

Unfortunately, Mrs B had a fall while transferring out of bed onto the commode and the wound dehiscenced across the suture line. Exudate levels were high due to the presence of oedema (Figure 5). Mrs B was keen to continue walking and consented to the Early Mobilisation Protocol.

#### Outcome

NPWT was commenced as discussed in the first case study and rehabilitation continued. Exudate levels were adequately managed without any damage to the periwound skin. Mrs B was cast for and fitted with a primary prosthesis.

The wound continued to improve. NPWT was discontinued prior to discharge home. Full wound healing was achieved following discharge (Figure 6). Mrs B initially managed independent downstairs living using her prosthesis, later progressing to walking up and down stairs.

#### Case report three

Mr C is a 67-year-old man who was admitted for a left transtibial amputation following the failure of a previous toe amputation to heal. His medical history included type 2 diabetes, which was treated with oral medications, peripheral arterial disease and chronic renal failure for which he underwent haemodialysis three times a week.

Following amputation, it was noticed that the posterior flap appeared mottled and the wound dehiscenced after removal of sutures. The surgical team were keen to take Mr C back to theatre to perform a transfemoral amputation, but having endured two operations already, Mr C was not keen to have further surgery. Mr C consented to the Early Mobilisation Protocol and following debridement of the majority of necrotic tissue, NPWT was applied (Figure 7).

#### Outcome

Mr C was able to continue therapy and be fitted with a prosthesis. NPWT was continued for eight weeks and discontinued prior to discharge (Figure 8). The wound continued to improve and full wound healing was achieved four months after discharge (Figure 9). Mr C is currently mobilising around his home using his prosthesis and a Zimmer frame.

#### DISCUSSION

In all three case reports, the patients had large, dehiscenced stump wounds producing high levels of exudate. Each patient was keen to continue active rehabilitation and avoid returning to theatre for transfemoral amputation.

The use of NPWT allowed exudate levels to be managed effectively while stimulating angiogenesis, thus promoting granulation tissue. All three patients were able to continue rehabilitation simultaneously.

Early mobilisation and provision of a primary prosthesis evaded the complications associated with immobility. Complete wound healing was achieved in all cases, preventing the necessity for further surgery and ensuring a superior functional outcome.

#### CONCLUSION

The results of these case studies indicate that NPWT is an effective way of managing dehiscenced amputation wounds, while continuing prosthetic rehabilitation. Wound healing was achieved in all of the three cases, preventing the need for revision surgery and optimising functional outcome. Early mobilisation and provision of a primary prosthesis also evaded the complications associated with immobility.

The case studies indicate that early mobilisation on unhealed wounds is beneficial to patients, but it requires a dedicated multidisciplinary team to ensure close monitoring of the wounds. This is carried out. It may be advantageous for other centres to adopt this practice, although further research may be required to support this. [WUK](#)