Larval therapy applied to a large arterial ulcer: an effective outcome

Linda Rafter

Abstract

This article is a review of larval therapy and includes a case study that uses larval therapy in the treatment of complex leg ulcer wounds. Complex wounds require careful management from the multidisciplinary team and present clinicians with intricate challenges to save the limb. Wound-bed preparation and debridement needs to be as effective and non-traumatic as possible for the patient. Larval therapy removes the devitalised tissue effectively with minimal tissue trauma. This case study reports on a patient with a non-progressing, full-thickness wound with exposed tendon following reconstructive surgery at a local vascular unit. The patient was left with very limited treatment options, as traditional dressings for the arterial ulcer nearly resulted in amputation due to the deterioration in the wound. As part of the patient's management, she was treated with larval therapy in an attempt to salvage her limb. This article follows the progress of complex leg ulcer wounds employing BioFoam® dressing (BioMonde, Bridgend) for larvae debridement therapy over a 4-week period and incorporating five applications of three BioFoam dressing bags. This care pathway ensured the patient's safety by promoting effective wound healing with the larval therapy leading to excellent clinical patient outcomes.

Key words: Larval therapy ■ Wound-bed preparation ■ Non-traumatic debridement ■ Effective wound healing

Larval therapy was first discovered to have the ability to heal open wounds by Maya Indians and Australian aboriginal tribes (Thornton et al, 2002). As early as the 16th century, French royal surgeon Ambroise Paré and in the 18th-19th, Napoleon's surgeon, Dominique Jean Larrey, noted that larval therapy had the ability to promote healing of soldiers' wounds that had become infected on the battlefield (Hinshaw, 2000).

Maggot therapy was reintroduced in the US in the 1980s and in the UK in 1990. Over the past decade, sterile maggots have become an acceptable form of treatment for the debridement of infected necrotic wounds (Thomas, 2006). Larval therapy is now widely employed in many countries and its use has continued to increase; up to 15 000 patients are treated annually with larval therapy in the UK and Germany alone (Jung, 2012). Despite larval therapy gaining in popularity and being a highly efficient method of chronic wound debridement, it remains aesthetically unappealing to some patients and nursing staff (Jones and Thomas, 2000). The increased use of larvae bags has helped with provision of up-to-date, honest information regarding the process involved in the treatment and perceived outcomes, encouraging practitioners and patients to be more accepting of larval therapy (Jones et al, 2011) (*Table 1*).

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Larval description

Lucilia sericata, the common green bottle fly, is the only fly species that is used for larval therapy in the UK. On the initial application to the wound, the larvae are 2-3 mm long, and grow to 8-10 cm when fully grown over a period of treatment from 5 to 7 days. The larvae have no teeth and so cannot bite or chew tissue. They move over the surface of the wounds and secrete a mixture of powerful enzymes, breaking down necrotic material and liquidising tissue (Jones and Thomas, 2000).

These larvae have the property of not damaging healthy dermis or the subcutaneous layer, but can destroy healthy epithelium. Therefore, with larval therapy, epithelium protection is mandatory at each change of gauze and pads (Gupta, 2008) and is delivered by a layer of thick barrier cream, such as Sudocrem.

Clinical evidence of larval therapy in treatment of chronic wounds

Larval therapy is thought to affect three components of wound healing: effective debridement of non-viable tissue, combat of infection by reducing the bacterial load, and may help to normalise wound healing by facilitating the remodelling process (Horobin et al, 2005). Larval therapy has been successfully employed in the treatment of chronic, infected wounds. In chronic wounds, the inflammatory response leads to tissue damage and prevents the progress of healing. The inflammatory response results in chemotaxis of the neutrophils into the tissue, which can be triggered by the complement activation, an essential part of immune system function. The anti-inflammatory effect caused by the larvae's secretions may help to explain the improved wound healing. The larval secretions decrease the inflammatory response; this allows the healing process to advance (Cazander et al, 2012). Larvae can change the wound pH and stimulate wound healing, which increases the oxygen within the tissues (Dougherty and Lister, 2008). Larvae also promote angiogenesis (growth of new capillary blood vessels) (Stoddard et al, 1995; Hall, 2010).

Table 1. Potential advantages and disadvantages of larval therapy	
Advantages	**Disadvantages**
Rapid but selective debridement	Availability
Reduction of bacterial burden	Slower than sharp or surgical debridement
Possible control of MRSA	Not suitable for all wounds
Possible chemical stimulation	Effectiveness limited by environment (wound pH, fluid and oxygen
No reported toxicity or allergenicity	Disposal
Source: Vowden and Vowden, 2002	

The method of debridement needs to be as non-traumatic and painless as possible for the patient. Larval therapy removes the devitalised tissue effectively with minimal trauma and combats infection (Calianno and Jakubek, 2006). Until the debridement is complete, full assessment of the wound bed cannot be completed, as it will slow the healing process and hinder the wound care pathway (Leaper, 2002).

The holistic approach to wound-bed preparation was developed to describe the wound situation of individual patients, in context with underlying disease and to provide the basis for removal of barriers to healing (Schultz et al, 2003). Prolonged inflammation, which is considered a barrier to wound healing, may be normalised by the effects of maggot debridement therapy on the complement system (Cazander et al, 2012).

Maggot therapy is thought to have an effect on at least three of the components of the TIME model (see *Figure 1*): it removes non-viable tissue by reducing the bio burden and helps to normalise wound closure by facilitating the tissue remodelling process (Horobin et al, 2005). As a consequence, moisture balance might also be normalised, as too much water or wrong wound fluid is often caused by excessive inflammation or infection, slough and dead tissue on the wound surface (Jung, 2012) (*Figure 1*).

Biofilms are defined as communities of multiple micro-organisms that are embedded within blanket slime. The implications of biofilms for wound management are uncertain, because diagnosing biofilm infections in wounds is not yet well developed (Cooper, 2010). They are considered to be potential problems that delay healing and play an important role in chronic wounds (Harding et al, 2011). The link between wound chronicity and biofilms has provided some valuable insight into the reasons some wounds fail to heal within predicted times, and it has created effective strategies to control biofilms (Cooper, 2010). Larval therapy may be of benefit in these cases, as the larval secretions can effectively prevent and remove biofilms (Cazander et al, 2010).

Rationale for employing larval therapy in the case study

The severity of the wounds meant that the case featured in this article involved a 4-week period of debridement with BioFoam® dressings (BioMonde). The larvae used in the dressing debride devitalised tissue through sealed net bags. The rationale for the use of the BioFoam dressings was the debridement of this arterial ulcer caused by the trauma of an injury on the patient's lower left leg some 9 months earlier.

Figure 1. 'TIME' model for wound care
T = Tissue type
I = The presence or absence of Infection and/or Inflammation
M = Moisture balance and avoiding desiccation or maceration
E = Wound Edges being non-advancing or non-migrating. The aim is to promote wound closure, therefore it is essential to remove the barriers to this
Source: Schultz et al, 2003; Dowsett, 2008

The rationale for using bagged larval therapy and not free-'range larvae was that the free-range would not have been encased and would have been more difficult for nursing staff to manage. The bagged application provided ease of use and nursing staff had familiarity with this application and the daily care and change of larval dressings. The BioFoam dressing was used for the chronic leg ulcer and the larvae bags were applied once every 5 days and remained in situ for that period.

Some patients experience pain while they are receiving larval therapy and the pain level must be assessed using a recognised tool so that adequate analgesia can be prescribed. In extreme cases, some patients require opioids to manage their pain and where unrelieved pain is severe, a continuous nerve block may be required (Mumcuoglu et al, 2012)

Objectives in wound management

Accurate assessment of a complex wound is essential for the multidisciplinary team and the patient to develop and agree an effective care pathway with clear objectives in order to give effective clinical outcomes (Stephen-Haynes, 2010).

The removal of the devitalised tissue will result in the following:

- Creation of the optimal wound healing environment by producing a vascularised, stable wound bed with minimal exudate (Vowden and Vowden, 2002)
- Reduction in the wound malodour (Vowden and Vowden, 2002)
- Lowering of the wound bioburden and therefore directly impacting on wound healing
- Promotion of the advancement of epithelial cells, enabling the restoration of the epidermis (European Wound Management Association (EWMA), 2004)
- A thorough wound assessment (Benbow, 2008).

Case report: larvae save Mrs W's limb

Mrs W is an 89-year-old woman who had a past medical history including angina and diabetes, which were controlled by diet. Mrs W had been widowed for some years and her daughter lived close by and was an invaluable support to her. She had enjoyed relatively good health and was a very active pensioner before the development of this ulcer. She had gone on trips with her peers and she went swimming at her local baths at least once a week. Mrs W was admitted with left-lower-leg ulcers and had a CT angiogram on 26 April 2012. This demonstrated that there were atheromatous plaques and calcification of the aorta, and common iliac and femoral arteries with evidence of arterial disease. On the right leg, the anterior tibial, posterior tibial and peroneal arteries showed narrowing. On the left leg, the femoral artery

and popliteal artery demonstrated there was extensive arterial disease. Mrs W was transferred to the vascular unit for right femoral reconstruction surgery and angioplasty. She had banged her right lower leg some 9 months previously, and had been managed at home by the district nurse team, but had not progressed and was referred to the local vascular unit for reconstructive vascular surgery.

Mrs W was readmitted on 13 May 2012 with a right lower leg wound that was nearly circumferential following reconstructive vascular surgery and angioplasty that had not been completely successful because the ulcer was non-healing.

The vascular surgeon and author discussed Mrs W's treatment care pathway. The treatment option considered was surgical debridement of the sloughy tissue, but because of the Achilles' tendon being involved and the implications of lost tissue on her mobility and suitability to return to theatre, this was not a viable option. Mrs W had not responded to treatment with traditional dressings of Sorbsan (Aspen Medical) and Eclypse (Advancis Medical) every 48 hours; the limb was infected with *staphylococcus aureus* light growth and *Proteus* spp heavy growth and she was therefore commenced on flucloxacillin. Since the author and the vascular surgeon had employed larval treatment successfully in previous care pathways, it was agreed that bagged larvae therapy would be of great benefit to Mrs W. She was quite happy to proceed with the larval therapy, as she knew the options were limited and was willing to try any treatment that would save her limb.

The author thought her limb was not salvageable and that the wound would result in amputation. On discussion with Mrs W initially, she was very open to using the larvae therapy as she realised there were limited options to save her right lower leg. The author gave her the patient information leaflet on larvae therapy outlining the advantages and disadvantages. She read this and the author returned to the ward when Mrs W agreed to give the larvae a try. On assessment, her right inner lower leg had a 26 x 13 c m wound. The wound bed consisted of 100% yellow, soft sloughy tissue and was down to tendon. All the Achilles' was exposed, wound edges were red and cellulitic, and there was a high level of exudate. The author was unable to feel pulses owing to oedema, there was no capillary fill, although the foot was warm, and the author was able to feel pulses at the knee. A Doppler was not possible because of the positioning of the ulcers. The patient gave permission for photographs to be taken for teaching and publication purposes (see *Figure 2*).

Primary goals of treatment

- Debride sloughed tissue from the wound bed
- Reduce bioburden and remove biofilms from the wound bed
- Reduce malodour
- Reduce pain and promote wound healing
- Prevent amputation of limb.

Care pathway

The author requested that Mrs W's lower legs were elevated on the bed as high as she could tolerate to help reduce the oedema. She was nursed on a Nimbus® 3 alternating mattress (Arjo Huntleigh), with 2 to 4 hourly changes of position. She was eating well and enjoying her food. Her Waterlow Score was 16 and her body mass index 27. Her MUST score was zero. Her serum albumin was low at 32, so she was slightly malnourished. Her haemoglobin of 10.9 and her white cell count of 9.6 were in the normal ranges and did not indicate any sign of infection.

The author advised that she have Sorbsan flat, an alginate dressing that can be removed by irrigation, and Eclypse 20 x 30 cm, a super-absorbent dressing that locks the exudate into the dressing. The dressings were secured with a toe-to-knee bandage every 48 hours. The rationale for these dressings was to allow easy removal and not to dry out the tendon tissue. The author encouraged improved dietary intake as the patient did require nutrition build up. The author discussed this case with the vascular surgeon and agreed a care pathway to try the larval therapy for 5 days, followed by a review of the outcome.

The author returned the next day (18 May 2012). On removal of the Sorbsan dressing, the author cleansed the wound with saline before applying the bagged larvae. The tissue was soft and pliable and the tendons were clearly visible. The author applied the first treatment of the three 10 x 10

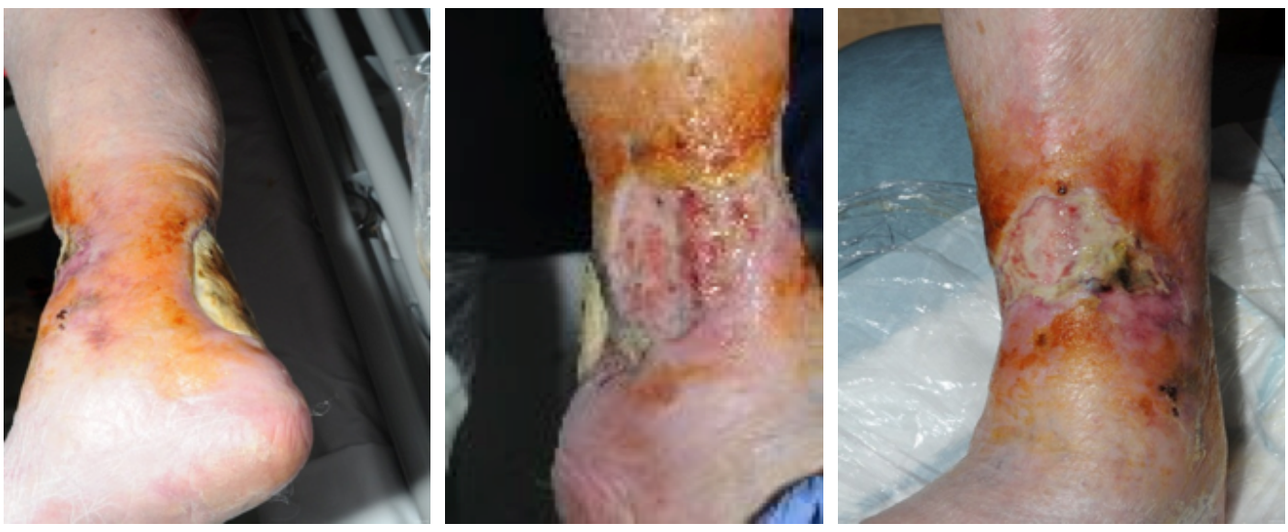

Figure 2. Mrs W's wounds were down to the tendon

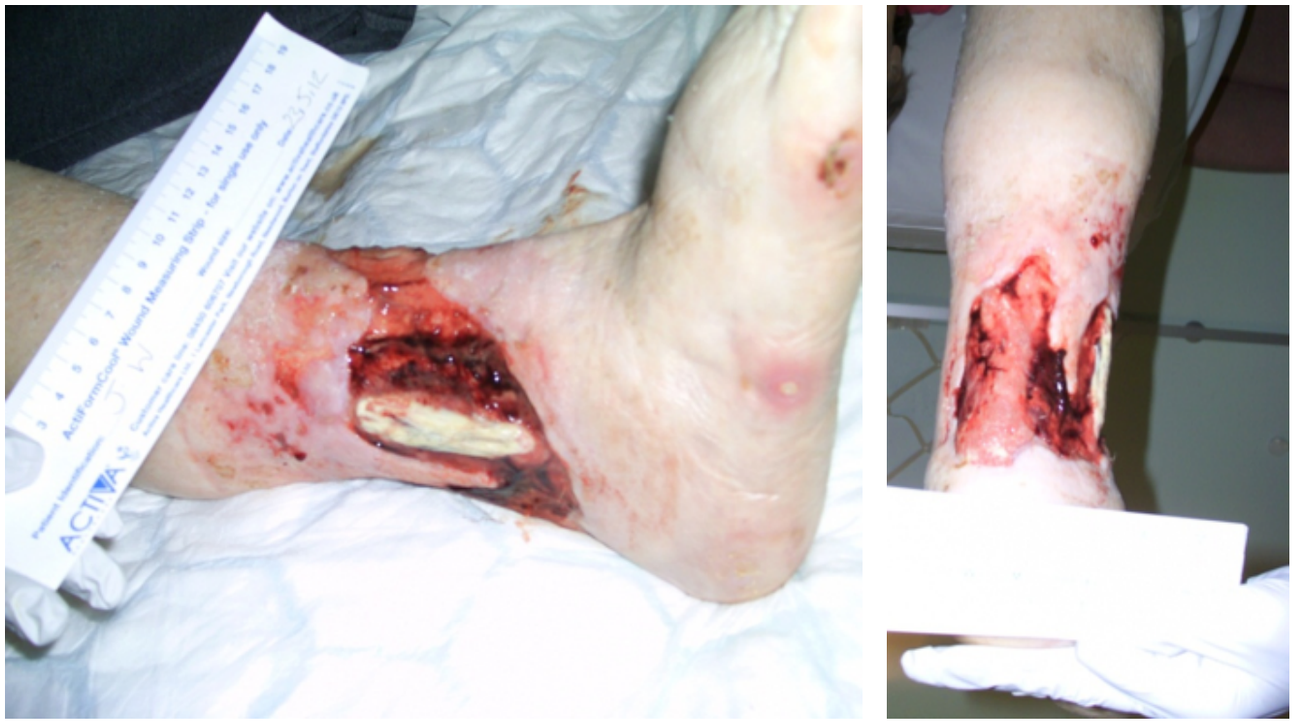

Figure 3. Mrs W. The larval therapy had debrided and there was evidence of new tissue being laid down

cm bags of larvae to the right-inner-lower-leg wounds. The author applied Sudocrem (Forest Laboratories UK) liberally around the wound to protect the skin from excoriation, as recommended by the company. Three bags of debridement larvae 10 x 10 cm, two pads of gauze and a large absorbent pad were secured with a bandage that would be replaced twice daily until the larvae removal on 23 May 2012.

The larvae were big and fat and very lively in all three bags on removal on 23 May 2012. The author reviewed the wounds with the vascular team and there had been a remarkable improvement, as the larvae had debrided the lower-leg wounds very effectively (see *Figure 3*). It was agreed to continue treatment for another 14 days at least and then review the outcome. The author applied Sudocrem liberally around the wound to protect the skin from excoriation, as recommended by the manufacturer. Three BioFoam dressing bags of debridement larvae 10 x 10 cm, two pads of gauze and a large absorbent pad were secured with a bandage that would be replaced twice daily until their final removal on 28 May 2012 (*Figure 4*).

Figure 4. Mrs W's wound healing on 28 May 2012

Again, the larvae were big and fat and very lively in all three bags on removal on 28 May 2012. The author reviewed the wounds with the vascular team and it was agreed there had been a continued remarkable improvement, as the larvae had again debrided the lower-leg wounds, allowing for effective wound healing to take place. There was good granulation tissue and the tissue being laid down over the tendon was covered (see *Figure 4*). It was agreed to continue the same treatment application for another 5 days at least and then review the outcome on 1 June 2012.

On 31 May 2012, the ward contacted the author as they were concerned that the wounds might be septic owing to the odour being produced by the larvae. However, when the author examined the wound bed, it was very healthy with 100% pink granulation tissue. The larvae were extremely fat and lively and the odour was as expected.

The author again applied Sudocrem liberally around the wound to protect the skin from excoriation. The same treatment as previous was used, with the removal to be on 7 June 2012.

On 7 June 2012, the author removed the larvae and they were very fat and lively (though less so than previous dressing removals). Larvae therapy was now complete. The right lower leg wound was now 4 x 9 cm with an island of epithelising tissue 6 x 14 cm and 100% pink granulation tissue. The author applied PolyMem Max® (PolyMem) to all wounds to assist the healing process, to be changed every 4 days. This was secured with a small surgical pad and bandage. The author advised that the PolyMem Max was to be continued to the lateral wound and secured with a toe-to-knee bandage. The author reviewed the patient 2 weeks later on 21 June 2012.

On 21 June 2012, the author reviewed Mrs W to ascertain

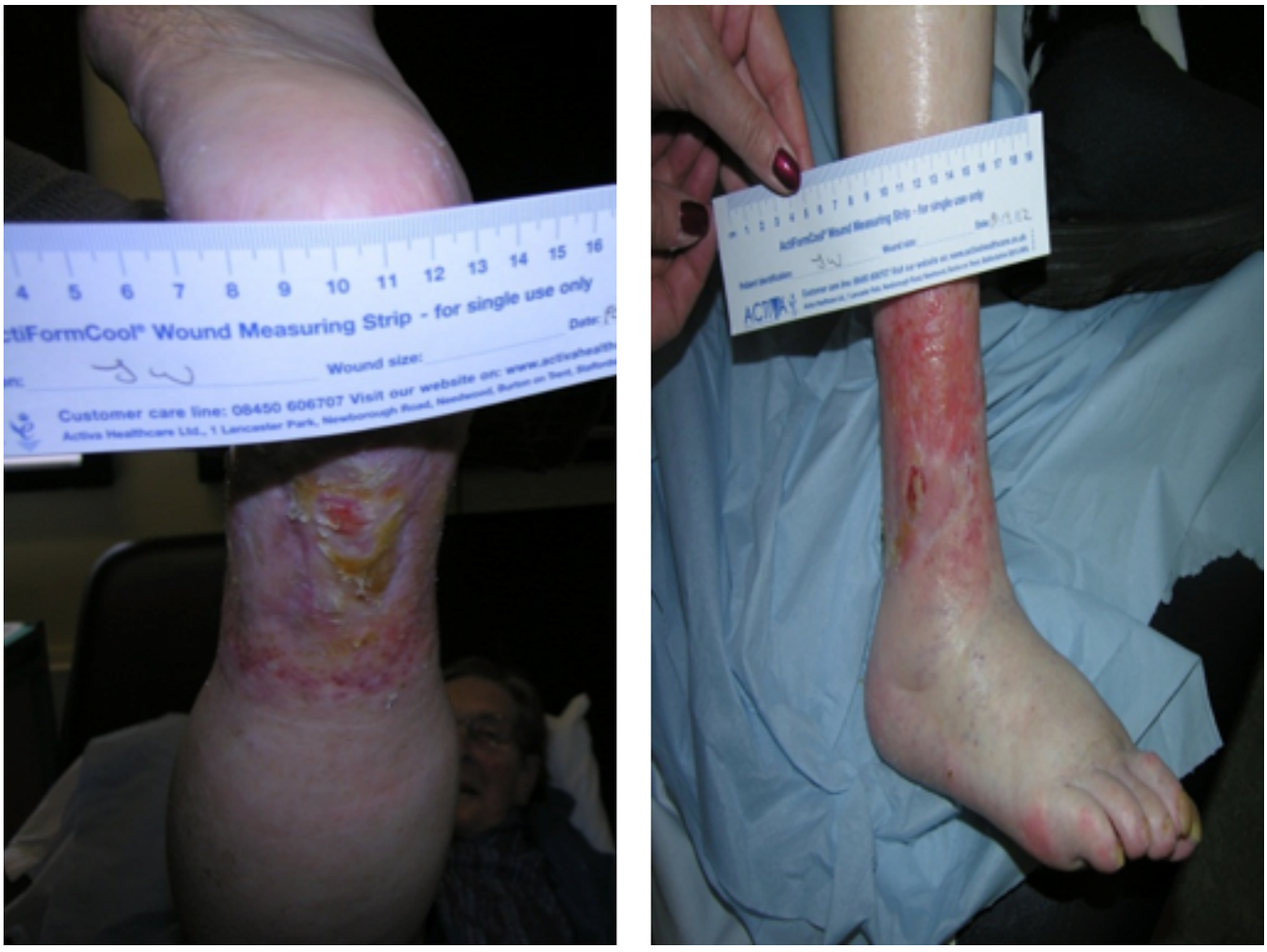

Figure 5. The wounds and progress of the outpatient on 22 October 2012

whether she was fit for discharge. The right-lower-leg wound had reduced to three wounds measuring 4.5 x 6 cm, 5 x 3.5 cm, 7 x 3 cm, and the wound bed consisted of 100% pink granulation tissue to wounds. There was some visible over-granulation present to the wounds which would settle down and flatten out over time. PolyMem Max was applied to all wounds to continue the healing process and was changed every 4 days. This was secured with a small surgical pad and bandage. The author arranged the outpatient appointment for 30 July 2012. District nurses were contacted to continue the dressing regimen and to ensure that Mrs W continued to elevate her lower leg. Her daughter initially had Mrs W at her home to ensure she had adequate rest.

The author reviewed Mrs W on 10 September 2012 and her right lower leg wound was then two distinct wounds measuring 2 x 1 cm and 1 x 1 cm with 100% pink granulation tissue to wounds. The wound edges were very moist and macerated. The author obtained photographs with Mrs W's permission (*Figure 5*). She had bilateral oedema and required more diuretics from her GP. The author advised changing the dressing to Aquacel® Hydrofiber® 15 x 15 cm, which helps to manage exudate, and Biatain® (Coloplast), a plain, non-adhesive foam, every 3 to 4 days to continue the healing process. This was secured with a toe-to-knee bandage to help reduce the swelling in the calf. Mrs W was advised to keep elevating her lower legs to reduce the oedema. She was given an outpatient appointment on 22 October 2012.

Mrs W attended a clinic appointment on 10 December 2012 and the photographs (*Figure 6*) demonstrate that she had nearly completely healed and only required moisturising cream. There was considerably less oedema than previously assessed. She asked if she could start swimming again and the author gave permission for her to do so.

Patient outcomes

Effective debridement of these complex leg ulcer wounds is challenging and multifaceted. It is essential a multidisplinary approach is adopted to enable cost-effective patient outcomes. This case study report provides insight into a patient journey employing BioFoam dressing for larvae debridement therapy over a 4-week period and incorporating five applications of three BioFoam dressing bags to complete healing.

If Mrs W were to have an amputation, patient considerations were as follows:

- Mrs W was 89 years old and the physical demands of adjusting to life with an amputation would have proved very difficult
- Mrs W would have had to have a below-knee amputation and there would be limited limb movement owing to the function of her knee
- How well she would have coped with the emotional and psychological impact of amputation at her age

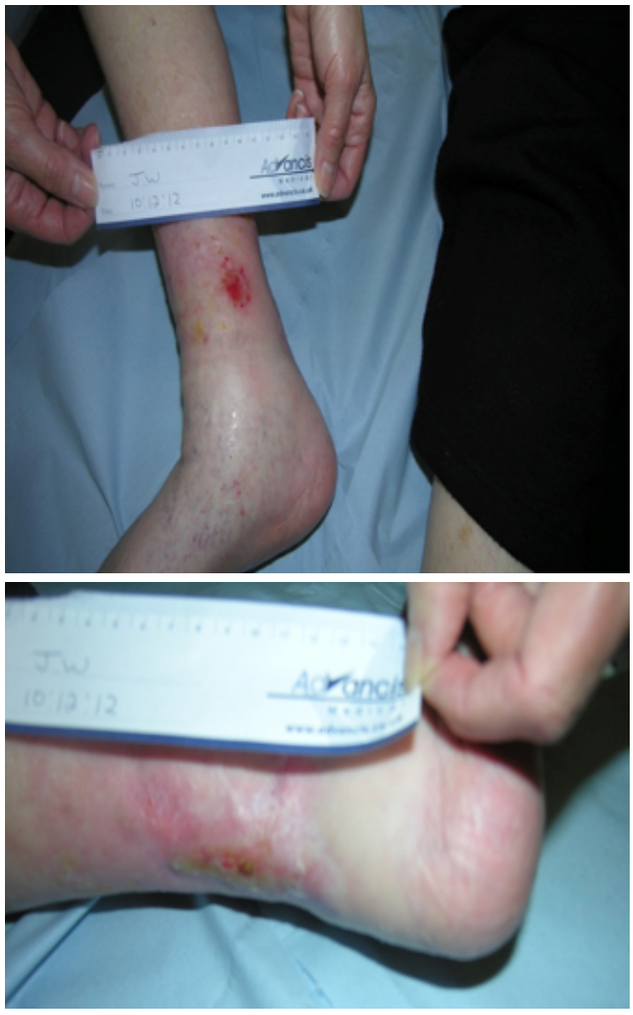

Figure 6. The final result of wounds and progress of the wound healing on 10th December 2012

- Mrs W would have required at least 2 to 4 weeks of rehabilitation in hospital to adjust to an amputation.

The vascular surgeon stated that larval therapy had debrided this wound very effectively and had promoted wound healing. The vascular surgeon stated it was a brilliant patient outcome that had salvaged Mrs W's limb after a failed femoral popliteal bypass.

Conclusion

Effective debridement in an arterial ulcer wound is very challenging for clinicians. It is essential that a multidisciplinary approach is adopted in this multifactorial condition to ensure that every problem is addressed. Treating the underlying problems and selecting a suitable care pathway is vital to the patient's recovery, and in this case saved her leg. The author was uncertain if this patient's limb could be salvaged and was astounded with the wound healing that resulted from the larval therapy.

While this is only one case study, bagged larvae had excellent results and a clear health gain for the patient. It did provide valuable insight into a successful treatment that occurred over a 4-week period of time, with five treatments of debridement with larval therapy followed by traditional wound management dressing to continue wound healing. Her daughter was delighted her mother avoided the need for an amputation and subsequent rehabilitation for months afterwards, when her mother may have ended up wheelchair-bound because of her age and comorbidities. The health gains for this patient were enormous and she is able to be mobile with a stick and has a good quality of life and is now back to swimming in her local baths. BJN

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KEY POINTS

- Effective wound-bed preparation and debridement needs to be as non-traumatic and painless as possible for the patient
- The patient in the case study was successfully treated with the larval therapy in an attempt to salvage her limb
- Biosurgery has been employed and used effectively in wound care for a number of years
- Patient outcome was better than expected and ultimately allowed the patient to keep her injured limb

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