

# Maggots down under

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## Abstract

Maggot debridement therapy (MDT) is an old form of wound care treatment that was used prior to the introduction of antibiotics. Maggots nurse a wound by the processes of debridement, disinfection, cleansing and healing. In the modern healthcare arena, new innovative methods that are being developed overseas for MDT are proving to be more acceptable to clinicians and patients – many wound care workers that have used MDT for the treatment of some chronic wounds in Australia have said they would recommend this therapy to their colleagues.

## Introduction

Chronic wound care provides the medical professional with an endless array of challenges. Most of these challenges are resolved through modern medical practices but, when these fail, an old fashioned remedy in the form of maggots for the more stubborn wounds might be just what the doctor ordered.

## Background

Biosurgery and biotherapy involve the use of leeches, bees and maggots (fly larvae) to treat patients for a variety of medical conditions. This emerging field of alternative medicine has slowly shed its medieval image to take its place in modern wound care. One form of biotherapy that has made a major comeback in the 21st century is maggot debridement therapy (MDT), also referred to as larval therapy. During the 1930-40s this therapy was used routinely in hospitals in some countries prior to the introduction of antibiotics.

Over the last 2 decades, MDT has won a hard-earned reputation and numerous accolades overseas as a simple, efficient, non-invasive and cost-effective means to debride chronic wounds where conventional methodology may have failed or was not a viable option. In the last 5 years, many major hospitals in Australia have used MDT for the treatment of some chronic wounds. Although many of the medical staff were sceptical and had preconceived ideas regarding MDT, they were surprised at the results this seemingly archaic therapy could achieve within just a few days.

MDT is the organised placement of sterile or disinfected (free of bacteria) maggots into a wound to cleanse the wound bed of devitalised tissue and promote healing. The main fly species that is used worldwide for MDT is the sheep blowfly, *Lucilia sericata* (Figure 1)<sup>1</sup>. The normal feeding behaviour of the larvae (maggots) of this fly is to feed solely on necrotic tissue, leaving the surrounding healthy tissue untouched. This is why not all fly species are deemed suitable for this specific purpose of wound care. These so-called ‘medicinal

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Figure 1. *L. sericata* adult flies that are used in association with MDT.

maggots' can benefit a wound by reducing the necrotic tissue, removing the pathogenic bacteria, and aid in the healing process by stimulating the growth of healthy granulation tissue<sup>2</sup>.

## History of MDT

Various native peoples, including the Australian aboriginal Ngemba, a tribe of western NSW<sup>3</sup>, knew of the healing powers of maggots. Historical details of battles fought centuries ago indicate the medical profession have long expressed an interest in the effects of maggots in wounds. However, during the American Civil War, Confederate army surgeon JF Zacharias is thought to have been the first to intentionally use maggots for wound cleaning<sup>4</sup>.

Planned experimentation involving the placement of maggots into flesh wounds of patients was not undertaken until the late 1920s when William Baer, an orthopaedic surgeon from the John Hopkins University in Baltimore, Maryland, began his treatments. His experiments encompassed the use of maggots from several different blowfly species, one of which was the blowfly *L. sericata*. Baer's unorthodox approach to wound care was highly successful and was subsequently adopted in many hospitals throughout Canada, USA and Europe during

the 1930s to early 1940s<sup>5</sup>. Medical journals from this period indicate that a range of afflictions were treated successfully with MDT including osteomyelitis, abscesses, carbuncles, burns, cellulitis, gangrene and leg ulcers<sup>6</sup>.

A survey of larval therapists in USA and Canada undertaken by Robinson during this time indicated that most doctors had a favourable opinion of MDT, although some objected to the high costs of maggots and the application of the cumbersome containment devices used to restrict the maggots' movements<sup>6</sup>. In the 1930s maggots were mass produced by some hospitals and at least two pharmaceutical companies, including Lederle Laboratories in the United States of America. During this period, 1000 sterilised maggots were advertised for US\$5 (equivalent to about US\$100 today)<sup>6</sup>. However, by the mid 1940s, MDT was being used infrequently as antibiotics and modern surgical techniques began to be introduced<sup>7</sup>.

Several decades passed before MDT was revisited as a viable treatment for chronic wounds. Early clinical trials indicated MDT still offered several benefits over its modern counterpart of wound care<sup>7</sup>. For example, this non-invasive therapy can be undertaken at medical centres, outpatients<sup>8</sup> or through a home visit by trained nurses, an action that can



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often avoid a future trip for the patient to theatre for surgical debridement. This therapy can also provide the patient with more independence<sup>9</sup> plus has the added bonus of delivering a major cost benefit to the health system. It is unaffected by other treatments such as systemic antibiotics, x-rays and hyperbaric treatment, and has few side effects. The odour levels that are often associated with these chronic wounds can be reduced, which in turn improves the patient's quality of life<sup>10</sup>. MDT is able to fast-track wound closure, and is effective in preparing the wound bed for treatment with other wound healing modalities<sup>11</sup> such as topical negative pressure.

## What's new about MDT

The new millennium has seen major changes for MDT, with several innovative methods being developed for delivering the maggots. Usually, MDT was performed using the classical system of 'free-range' maggots, wherein the larvae were confined to the wound site by dressings; however, escaping maggots were a common problem. In 2002, the 'Biobag'<sup>12</sup> system (a containment bag) was introduced. With this device the maggots are heat sealed into a fabric pouch that enables the flow of secretions from the maggots to the wound site<sup>13</sup>. The Biobag system is easy to position and remove from the wound site, and has several advantages, including secure containment and control of maggots, plus the added bonus of reduced visibility of the fly larvae. More recently the BioFOAM dressing was released, which, according to the manufacturer, claims to provide "a physical environment that appears to markedly stimulate the activity and development of the maggots whilst assisting with exudate management"<sup>14</sup>.

These techniques have assisted MDT to become a more simple form of wound care that is acceptable to patients and clinicians through concealment<sup>12</sup>. Although MDT is not a cure for all wounds, this therapy has been shown to be very effective for pressure ulcers (bed sores), venous stasis ulcers, neuropathic foot ulcers (like diabetic foot ulcers) non-healing traumatic and post surgical wounds and burns<sup>15</sup>. Life threatening conditions such as temporal mastoiditis and gangrene have also been treated successfully with MDT after unsuccessful treatments with antibiotics and surgery<sup>16</sup>.

In 2004 MDT reached several medical milestones. Approval was granted in the UK for doctors to prescribe maggot therapy as an accepted procedure for wound care on their national health system. The granting of this approval was estimated to save \$2.5 billion per year to Britain's National Health Service<sup>17</sup>. In the same year, the United States Food and Drugs Administration (FDA) granted permission for "the production and distribution of medical maggots" to be marketed as a medical device for wound care<sup>18</sup>. This decision had an immediate effect, with the demand for MDT doubling,

and it is predicted that MDT will steadily increase in the future.

During 2005, in Europe alone, it was estimated that approximately 30,000 MDT treatments were undertaken<sup>19</sup>. There are now over a dozen countries that routinely utilise medical maggots for wound care; several of these countries have a mass production plant that provides a constant source of medicinal maggots. The interest in MDT has driven a demand for information on this topic; short courses in MDT are now available within USA and UK. In addition to this, most countries, including Australia, now cover MDT within the teaching curriculum for nursing and other related medical fields.

## MDT in Australia

Increased awareness and exposure to the benefits of MDT has gained the attention of many healthcare workers throughout Australia. The Department of Medical Entomology at Westmead Hospital has fielded many enquiries relating to MDT since the late 1990s. The enquiries and public interest encouraged the establishment and maintenance of a colony of *L. sericata* to produce disinfected maggots for the specific purpose of wound care<sup>20</sup>. In the late 1990s, MDT was provided for several patients within Australian healthcare facilities, but in most cases it was viewed as salvage therapy prior to amputation.

As more information has filtered through, and increased numbers of medical staff have encountered MDT, the considered use of MDT has slowly changed and it is now viewed in a more positive light as an alternative therapy for cleansing sloughy wounds. At the Royal Australasian College of Surgeons Annual Scientific Congress at Perth in May 2005, the results of a trial were presented where MDT was used on nine patients in a Tasmanian hospital<sup>21</sup> and the chief executive of the hospital stated "the treatment has been excellent and very successful"<sup>22</sup>.

In the last 4 years, the Medical Entomology Department at Westmead Hospital has supplied disinfected maggots (Figure 2) for patients in many major hospitals in all states throughout Australia as well as to other countries, including three teaching hospitals in Japan. The Department currently produces only limited quantities of disinfected maggots as per the methodology that Sherman & Wyle outlined for low cost rearing in hospitals and clinics<sup>23</sup>. This provision of disinfected maggots is at present relatively restricted by available resources as the low profile and indifferent image of MDT, and the lack of clinical trials within Australia, have prevented the expansion of this potentially valuable service.



Figure 2. Vials of early second instar *L. sericata* maggots used in wound debridement.

To gauge the interest and success of MDT within Australia since its introduction in 2004, 10 healthcare facilities (which included several major hospitals and other medical centres) that had used MDT during 2006 were supplied with a questionnaire (Table 1). A total of 60% of the surveys were completed; these indicated that a total of 22 patients from six healthcare facilities throughout Australia had undergone MDT during 2006. Each wound care worker that completed the survey considered the outcome of MDT on the patient to be a good or excellent result.

All of the patients were elderly with ulcers located on the limbs or feet, with the exception of one patient with a wound on the sacrum. Side effects were minimal; one patient complained of increased pain which was controlled with analgesia, another patient experienced a crawling sensation. In each case, traditional wound care therapies had been used prior to MDT, these included vacuum dressings, silver dressings and hydrogels, with only two of the patients undergoing surgical debridement. Objections from assisting nursing staff were experienced in three cases and, at one hospital, some of the nurses refused to participate in the wound management. However, the feedback from the patients that had undergone MDT was positive in all cases surveyed. The survey indicated that each wound care worker that had used MDT would consider using it again, and thought it to be a fast and cost-effective treatment. Each participant surveyed stated they would recommend MDT to their colleagues.

A case study of a patient with a diabetic foot ulcer that underwent MDT at the Royal Hobart Hospital Tasmania is presented below.

### Using MDT for the treatment of a diabetic foot ulcer: a case study

MDT has been used at the Royal Hobart Hospital since January 2004 when the first batch of maggots was imported

Table 1. Questionnaire

In order to gauge the success of maggot debridement therapy (MDT) in Australia, we are asking our customers to complete a short questionnaire

1. Would you consider the results you achieve through MDT a ... (please check ONE box only)
 

<input type="checkbox"/> Failure	<input type="checkbox"/> Poor result
<input type="checkbox"/> Good result	<input type="checkbox"/> Excellent result
2. How many patients have you treated with MDT? Please use one survey form per patient \_\_\_\_\_
3. Details of MDT patients:
  - a. Were they a diabetic patient?  Yes  No
  - b. Age group?  40-50  51-60  61-70  Other \_\_\_\_\_
  - c. Type of wound treated \_\_\_\_\_
  - d. Where was the wound located? \_\_\_\_\_
4. Did the patient complain of any side effects, e.g. pain or crawling sensation? If so, did the treatment cease as a consequence? \_\_\_\_\_
5. Would you use MDT again?  Yes  No  
If not, could you share your reasons why? \_\_\_\_\_
6. Did you have any objections from your staff or patients in relation to this therapy?  Yes  No
7. Did you find the treatment cost-effective?  Yes  No  
Comments, if any: \_\_\_\_\_
8. What other therapies were used prior to or in conjunction with MDT? \_\_\_\_\_
9. Would you consider MDT a relatively fast or slow method of wound care?  Fast  Slow  
Comments, if any: \_\_\_\_\_
10. Did you find the MDT instruction sheet helpful?  Yes  No  
Comments, if any: \_\_\_\_\_

Thank you for your valuable feedback.

from the Department Medical Entomology at Westmead Hospital. As the first Australian hospital to use this resource, it has now treated approximately 65 patients, with the majority having diabetic neuropathic foot ulcers. MDT has also been used on several occasions prior to skin grafting and also to rescue an infected split skin graft.

The first patient selected for MDT at the hospital highlighted the usefulness of this therapy as part of his complex multidisciplinary care plan. Mr B was a 60-year-old man with a 21-year history of type 2 diabetes mellitus. His past medical history included peripheral vascular disease, hypertension and

hyperlipidemia. He presented to the emergency department with an ulcer on his left lateral heel. This wound was of 4 months' duration following a minor traumatic injury which had failed to heal. He was febrile, felt systemically unwell, his c-reactive protein level was 204, his haemoglobin was 87 and there was purulent discharge from the wound. Blood sugars ranged from 22-30. The signs of inflammation and infection are absent or reduced in many diabetic patients<sup>24</sup>. Diabetics have impaired neutrophils, fibroblasts and leukocyte activity as well as impaired migration and action of inflammatory cells to the wound site increasing the risk of infection<sup>25</sup>. The presence of symptoms usually suggests substantial tissue damage or abscess development<sup>26</sup>.

In Australia approximately 520,000 people are diagnosed with diabetes and it is estimated that at least this number again are undiagnosed<sup>27</sup>. In 2000-2001, the National System for Monitoring Diabetes reported the total health expenditure on diabetes in Australia to be \$814 million. The most common reason for hospital admission for diabetics is foot complications. In Australia there are about 2,629 diabetes-related lower limb amputations every year<sup>28</sup>. National guidelines recommend that people with diabetes with foot ulcers or with high-risk feet be cared for by a multidisciplinary service. There is level 111-2 evidence that such a team can reduce ulceration and amputation in people with high-risk feet<sup>29</sup>. The Royal Hobart Hospital has a multidisciplinary high-risk foot clinic which coordinates the care of these patients.

Urgent and expert care was required by Mr B in order to prevent lower leg amputation. He was admitted for in-patient care and an urgent vascular review was organised. Intravenous antibiotics were commenced. An arterial doppler ultrasound showed occlusion of the superficial femoral artery and 50-70% narrowing in the distal superficial femoral artery. Angioplasty was carried out and perfusion to the lower limb was improved. Two units of packed cells were given to correct his anaemia. A bone scan and subsequent gallium scan revealed osteomyelitis in the calcaneum. The osteomyelitis was treated and monitored by our infectious diseases team. He had surgical debridement of his heel which revealed a large abscess. Not all necrotic tissue could be safely removed and, after discussion with Mr B, a decision was made to use MDT because of the state of his wound (Figure 3).

Approximately 100 maggots were applied to Mr B's wound bed and left for 72 hours. The wound was checked each nursing shift with a change of outer dressings as necessary depending on exudate levels. The periwound skin was protected by the use of a transparent hydrocolloid dressing prior to the maggots which were transferred on to moist non-woven gauze and then sealed in place with a film dressing.



Figure 3. Pre-MDT application.

Air holes were inserted in the film dressing every centimetre to prevent maggot suffocation. A waterproof tape was used at the edges of the dressing to provide extra security and to prevent maggot escape. Light cotton outer dressings and loose tubular bandaging was applied to protect the area (Figure 4). Mr B had only one treatment using maggots, reflecting the hospital's lack of experience. With the benefit of hindsight, the patient would have benefited from a repeat treatment to remove residual slough.

Post-MDT and to further prepare the wound bed, Mr B was commenced on topical negative pressure therapy (TNP) in preparation for skin grafting. TNP is described as the application of a vacuum force across the wound surface using a foam dressing interface enclosed by a sealed drape<sup>30</sup>. This treatment acts to remove interstitial fluid and deliver mechanical stress to the wound bed to increase blood circulation and increase granulation. Mr B was also given 52 treatments of hyperbaric oxygen therapy (HBOT). The rationale for adjunctive HBOT in chronic wound care is the premise that the underlying problem can be hypoxia<sup>31</sup>.



Figure 4. The wound 72 hours later, on removal of maggots.

Transcutaneous oximetry at the wound edges showed tissue hypoxia with good response to 100% oxygen at 2.4 ATA. Following wound bed preparation, Mr B was successfully grafted. To protect his new graft and to ensure that pressure to this area was offloaded, our high-risk foot clinic podiatrists altered and padded his footwear accordingly. This patient still has an intact foot in 2008.

In summary, the hospital's first experience in using maggots for wound debridement was very successful; it has gone on to utilise this form of treatment for at least 65 other patients. There are many factors which influence wound healing and a multidisciplinary team approach is important in identifying and controlling these factors. MDT should be given consideration as part of an overall care plan for patients with complex necrotic wounds.

## Conclusion

Disguised in a dressing or by terminology, there is no easy way to change the image of MDT. It will always remain an objectionable form of treatment to many, but it does serve a valuable role as a simple, quick and economical method to cleanse and initiate the healing of some stubborn wounds. As more clinical trials are undertaken worldwide, the delivery system for maggots is becoming more streamlined and the number of successful treatments is escalating.

Biosurgery is becoming demystified and accepted through education. It stands to reason that this therapy may, in time, become just another course of action for the wound care professional to consider when faced with the dilemma of treating a chronic wound. At present, within Australia, the use of MDT remains low key although, in the limited capacity in which it has been utilised, it has proven to be a valuable tool for wound care and has the added incentive of possible financial savings to health budgets.

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