Maggot Debridement Therapy (MDT)

The following information was written by Ronald A. Sherman, MD

Maggot Debridement Therapy (MDT) is the medical use of live maggots (fly larvae) for treating non-healing wounds.

In maggot debridement therapy (also known as maggot therapy, larva therapy, larval therapy, biodebridement or biosurgery), disinfected fly larvae are applied to the wound for 2 or 3 days within special dressings to keep them from migrating. The literature identifies three primary actions of medical grade maggots on wounds:

1. They clean the wounds by dissolving dead and infected tissue ("debridement");
2. They disinfect the wound (kill bacteria);
3. They speed the rate of healing.

The following topics about maggot therapy are detailed below:

- History of maggot therapy
- Current status of maggot therapy
- Biology of flies and maggots
- Advantages and disadvantages of maggot debridement therapy ("MDT")
- Common misconceptions about maggot therapy
- Information for health care providers
- Information for patients
- How to find a therapist
- Frequently asked questions
- Producers and distributors of medical-grade maggots
- References and links

History of Maggot Therapy

Maggots have been known for centuries to help heal wounds. Military surgeons noted that soldiers whose wounds became infested with maggots had better outcomes than those not infested. William Baer, while at Johns Hopkins University in Baltimore, Maryland, may have been the first in the Northern Hemisphere to have intentionally applied larvae to wounds in order to induce wound healing. During the late 1920's, he identified specific species, raised them in the laboratory, and used their larvae to treat several children with osteomyelitis and soft tissue infections. He presented his findings at a surgical conference in 1929. Two years later, after treating 98 children, his findings were published posthumously.

MDT was successfully and routinely performed by thousands of physicians throughout the 1930's, but soon it was supplanted by the new antibiotics and surgical techniques that came out of World War II. Maggot therapy was occasionally used during the 1970's and 1980's, but only when antibiotics, surgery, and modern wound care failed to control the advancing
wound.

The first modern clinical studies of maggot therapy were initiated in 1989, at the Veterans Affairs Medical Center in Long Beach, CA, and at the University of California, Irvine, to answer the following questions:

1. "Is maggot therapy still useful today?"
2. "Should maggot therapy be used as an adjunct to other treatments, not merely as a last resort?"
3. "How does maggot therapy compare to other treatments at our disposal?"

The results of those controlled comparative clinical trials and the many studies and reports that followed, indicate that MDT is still useful today as a safe and effective treatment tool for some types of wounds. Those studies also demonstrated that there is no reason to withhold MDT until all other modalities have been exhausted, nor use it only as a "last resort." Indeed, while published accounts of “pre-amputation MDT” show a limb salvage rate of over 40%, the success of MDT when used earlier in the course of treatment (say, as a 2nd or 3rd or 4th line treatment) is even more dramatic.

Current status of maggot therapy

In 1995, a handful of doctors in 4 countries were using MDT. Today, any physician in the U.S. can prescribe maggot therapy. Over 4,000 therapists are using maggot therapy in 20 countries. Approximately 50,000 treatments were applied to wounds in the year 2006.

In January 2004, the U.S. Food and Drug Administration (FDA) began regulating medicinal maggots, and allowed the production and marketing of one particular strain of Phaenicia sericata larvae marketed under the brand name Medical Maggots (TM). In February, 2004, the British National Health Service (NHS) permitted its doctors to prescribe maggot therapy. Patients no longer have to be referred to one of a few regional wound-specialty hospitals to get maggot treatments.

The BioTherapeutics, Education & Research Foundation was established in 2003 for the purpose of supporting patient care, education, and research in maggot therapy and the other forms of symbiotic medicine (diagnosing and/or treating diseases with live animals, such as maggot therapy, leech therapy, honey bee therapy, pet therapy & sniffer dogs, ichthiotherapy, bacteriotherapy etc).

Biology of flies and maggots

Maggots are fly larvae, or immature flies, just as caterpillars are butterfly or moth larvae. Maggots do not appear all by themselves ("de novo"), as was believed 150 years ago; they hatch from eggs, laid by adult female flies.

Not all species of flies are safe and effective as medicinal maggots. There are thousands of species of flies, each with its own habits and life cycle. Some fly larvae feed on plants or animals, or even blood (i.e., mosquitoes). Others feed on rotting organic material.

Those flies whose larvae feed on dead animals will sometimes lay their eggs on the dead
parts (necrotic or gangrenous tissue) of living animals. When maggots are infesting live animals, that condition is called “myiasis.” Some of those maggots will feed only on dead tissue, some only on live tissue, and some on live or dead tissue. The flies used most often for the purpose of maggot therapy are "blow flies" (Calliphoridae); and the species used most commonly is Phaenicia sericata, the green blow fly.

A diagram and photograph of a typical blow fly life cycle appears below

(used with permission of the BTER Foundation)

Advantages and disadvantages of maggot debridement therapy ("MDT")

- Efficacy, as demonstrated in several small but significant controlled clinical studies.
- Takes about 15-30 minutes to apply a secure dressing to keep the maggots in place.
- Excellent safety record.
- Maggots are highly perishable and should be used within 24 hours of arrival.
- Simple enough that non-surgeons can use it to provide thorough debridement when surgery is not available or is not the optimal choice. This means that it is also possible to provide surgical quality debridement as an outpatient or in the home.
- Low cost of treatment.
### Common misconceptions about maggot therapy

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<thead>
<tr>
<th>Common Misconceptions</th>
<th>The Truth</th>
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<tbody>
<tr>
<td>“Patients would not want maggots on them”</td>
<td>What patients do not want is a stinking, draining wound. What patients do not want is to lose their foot. What patients do not want is 4 more weeks of a treatment in which they do not see any benefit. To someone with a non-healing wound, wearing “baby flies” for 2 days is not too high a price to pay, if the potential for success is what is reported with MDT.</td>
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<td>“It might not be possible to get out all the maggots after treatment”</td>
<td>The maggot dressing is removed as soon as the maggots have finished secreting their proteolytic (tissue-dissolving) enzymes (within 48-72 hours). At that time, their natural instinct is to leave the wound and crawl away as quickly as possible. So when the dressing is opened, the maggots will be “at the gate,” eagerly awaiting their release. If any slow growing larvae remain, they can be removed with a simple wipe, wash, or irrigation.</td>
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<td>“If one of the maggots is left in, it might bury itself in the tissue or crawl around”</td>
<td>If any maggot is overlooked (for example, it was slow growing, and hid in the recesses of the wound when the dressing was opened), it will continue to feed on the dead tissue of the wound only as long as dead tissue is present, and probably only for a maximum of 12-24 hours. Medical grade maggots do not bury in or feed on healthy tissue. What’s more, they are obligate air-breathers. Therefore, they must remain where there is air, and they will leave the body as soon as they are finished feeding or as soon as there is no more dead, infected tissue left.</td>
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<td>“Medicinal maggots are sterile, so they can not reproduce or turn into flies”</td>
<td>Medical grade maggots are often called “sterile maggots,” but the use of the word “sterile” means germ-free. They are best called “disinfected maggots.” They can mature into flies (although it will take them about 3 weeks, and they can then reproduce. However, all larvae are immature, and can not reproduce until reaching adulthood.</td>
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<td>“Medicinal maggots might reproduce in the wound, making even more maggots”</td>
<td>Not true. Larvae of all species are immature, and can not reproduce.</td>
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<td>“Medicinal maggots are no longer available”</td>
<td>Medical maggots are readily available from several sources, in many countries. See below for a list of suppliers.</td>
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<td>“Medicare, Medicaid, and private insurance will not cover maggots or maggot therapy”</td>
<td>In the U.S., maggot therapy should be coded with an appropriate procedure code for “selective debridement without anesthesia” (i.e., CPT codes 97597 or 97598) or a CPT code for misc. skin procedures (i.e., 17999). While it is true that CMS declined to issue a national code (HCPCS code) for the maggots themselves, they can and should be billed as an additional expense, and will generally be covered by private and governmental third-party payers. When billing for the maggots themselves, consider using either the ABC code for maggots (EAACT) or the HCPCS code for misc. devices (A9270). Appeal may be necessary. The BTER Foundation will assist with appeals. For those without financial resources, the BTER Foundation provides Patient Assistance Grants. Additional information can be found in the recent press release by the BTER Foundation.</td>
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<td>“Maggot therapy might hurt if the maggots bite me”</td>
<td>Maggots do not bite. They do not have teeth. They do have modified mandibles though, called “mouthhooks,” and they have some rough bumps around their body which scratch and poke the dead tissue, one of the mechanisms that debrides the wound. It is similar to a surgeon’s “rasper,” but on a microscopic scale. The maggots are so small when applied that they can not even be felt within the wound. Those patients who already have wound pain before beginning maggot therapy, perhaps due to exposed nerves or other reasons, may have some pain during maggot therapy when the maggots become large enough to be felt crawling over those nerves (usually at about 24 hours). Those patients should be given access to pain medications (analgesics); but if pain medication is inadequate to relieve the discomfort, the maggots can be removed early. Once the dressings are removed, the maggots will crawl out and the pain should cease immediately. If further debridement is necessary, another MDT dressing can always be applied later, but it should be</td>
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used only for a brief period, again, until the patient is uncomfortable.

| “Sure, medical maggots are cheap; but garbage maggots are even cheaper, and should be just as good” | While it is true that the species used to make medical grade maggots are found in the wild, so too are thousands of other species; and not all species are safe and effective. In fact, the literature suggests that not all strains of the same species are equally safe and effective. What’s more, wild maggots may carry pathogens even more harmful than the ones already on the wound. Therefore, it is prudent to use medical grade maggots that have been demonstrated to be disinfected (germ-free), safe, and effective. |

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**Information for health care providers**

Medicinal maggots have three actions: 1) they debride (clean) wounds by dissolving the dead (necrotic), infected tissue; 2) they disinfect the wound, by killing bacteria; and 3) they stimulate wound healing.

In the U.S., indications listed on the package insert include: “... debriding non-healing necrotic skin and soft tissue wounds, including pressure ulcers, venous stasis ulcers, neuropathic foot ulcers, and non-healing traumatic or post surgical wounds.”

There are many reports about maggot therapy also being used for other wounds, such as burns, osteomyelitis, fasciitis, clean but non-healing wounds ... but these are not currently approved indications for any medicinal maggots currently on the market.

The BTER Foundation, in collaboration with community leaders, drafted a MDT Policies & Procedures template for hospitals and clinics to use when writing policies for their facility. The template is available for free download.

For more details about the specific application procedures, readers are referred to the manufacturer’s directions. A list of manufacturers can be found elsewhere on this site.

The BioTherapeutics, Education and Research (BTER) Foundation has produced a workshop to train health care providers in the Principles and Practice of Maggot Therapy. The workshops are held in cities across the U.S., as invitations and co-sponsors present themselves. Participants learn the indications, contraindications, and techniques of maggot therapy during this 6-hour didactic and practical (“hands-on”) training workshop.

For more information about the curriculum and the upcoming workshops, visit the MDT Workshop Website or contact the BTER Foundation.

**Information for patients**

Maggot therapy is an effective, accepted method of treating chronic, non-healing wounds.
Only specially selected, tested, disinfected larvae are applied to the wound surface and covered with a dressing that prevents the larvae from escaping. They are easily and completely removed 2 or 3 days later. Sometimes the wound is completely cleaned by then; sometimes additional treatments may be necessary. After maggot therapy, the wound may be clean enough to close, cover, graft, or flap. Your doctor will be able to suggest the best treatment to follow.

If you do not have insurance, Medicare or Medicaid, and if you do not have the financial means to cover the cost of treatment, ask your doctor to provide the service at a reduced fee, and apply for a Patient Assistance Grant from the BTER Foundation to cover the cost of the maggots.

How to find a therapist

If you are looking for a therapist to evaluate your wound for maggot therapy, first ask your current physician or surgeon. S/he knows you already, and can provide local care and follow-up. The procedure is simple enough that most licensed therapists can do it with ease. Courses are available (see BTER Foundation) and your current doctor or wound care therapist may have already had experience.

If that is not possible, or if your therapist would like to speak with others who have more experience, a list of referrals and consultants can be found at www.ucihs.uci.edu/som/pathology/sherman/mdtists1.htm. Also, try contacting your local supplier of medicinal maggots for a referral.

Frequently asked questions

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<th>Question</th>
<th>Answer</th>
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<td>How do you keep the maggots on the wound?</td>
<td>Because the natural tendency of the maggots is to wander off before and after they have finished feeding, they must be kept in place by dressings that allow air to enter, allow liquefied necrotic tissue to drain out, and still keep the maggots securely over the wound. This can be done with a porous, mesh-like covering (i.e., nylon netting) affixed to the wound border (by tape, or glued to a hydrocolloid pad). It is removed 48-72 hours later, and the maggots removed.</td>
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<td>How do you get all of the maggots out?</td>
<td>Once the dressing is removed, all of the maggots should crawl out of the wound and away from the host because they will be satiated and ready to migrate. Remaining maggots can be wiped off with a wet gauze pad. If there are any young larvae still there that you can not remove, simply cover the wound with moist gauze and replace it three time/day; the</td>
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<td>Question</td>
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<td>How do I dispose of the maggot dressings?</td>
<td>Maggots are germ-free when applied, but become contaminated when they come into contact with the patient’s wound flora. Therefore, MDT dressings should be handled like all other infectious dressing waste. Place the maggot dressings in a plastic bag and seal the bag completely. Then place the sealed bag into a second plastic bag and seal completely. Place the bag with the other infectious dressing waste in an appropriate infectious waste bag and autoclave or incinerate within 24 hours, according to waste management policies.</td>
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<td>How do I dispose of unused maggots?</td>
<td>Unused maggots are germ-free. They may be discarded in regular trash bins. Seal their vial so that they can not escape.</td>
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<td>How many treatment cycles are necessary?</td>
<td>The number of treatment cycles depends on the size of the wound and the ultimate goal of treatment (debridement, wound preparation for graft, or wound closure). The average course is 2-4 cycles. Examine the wound after treatment (and 24 hours later, if possible), to determine if another treatment is necessary.</td>
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<td>Does maggot therapy hurt?</td>
<td>For those few patients who feel wound pain, they will likely also feel pain or discomfort with maggot therapy as the maggots become large enough to feel (about 24-36 hours into the treatment cycle. Use analgesics liberally, and remove the dressings if/when analgesics fail to control pain. The pain will abate immediately after the dressing is removed.</td>
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