

Maggots! -Lending a helping hand in wound management-a review

¹Olaitan P. B, ² Olaitan J. O

¹Departments of Surgery, Lautech Teaching Hospital, Osogbo, Osun State, Nigeria

²Department of Biological Sciences, Osun State University, Osogbo, Nigeria

Correspondence to Dr. Olaitan PB. Email: emiolaitan@yahoo.com

Abstract

Background: *Wound care in the developing world is often problematic. From the point of delay in presentation to inability to get fund for debridement and other surgical treatment, patients often carry the wounds for a prolonged period with attendant serious economic loss. A way of solving this would therefore be finding an appropriate, cheap and safe method of attending to these wounds. Maggot Debridement Therapy (MDT) has found significant use in many countries including the developed countries like U.S.A. and UK . It is safer, cheaper than surgery and enables the patient to have a faster debridement and wound healing.*

Methodology: *A review of the literature to assess the effectiveness, clinical applications and safety of the Maggot Debridement Therapy was done on the internet using search engines like Google, Pub Med etc.*

Findings: *About 400 articles and abstracts written on maggots and maggot debridement therapy were reviewed. They show different uses to which maggots have been put and the advantages especially in chronic, ischemic ulcers. Sterile larvae of the common green bottle, *Lucilia sericata*, have been shown to be a highly cost-effective alternative to conventional treatments for the debridement and cleansing of all types of chronic wounds. **Conclusion:** Maggot Debridement Therapy has found its usefulness in dressing difficult/chronic wounds. It also debrides wound quicker than conservative wound dressings. It has been found to be safe and cheap and enhances wound healing.*

Key words: Maggots, helping, wound, management.

Introduction

Chronic wounds are a challenge for modern health care. A basic principle of treatment is the removal of sloughy, necrotic, devitalized tissue to prevent wound infection and delayed healing¹. The problem, as many “hands on” doctors know, is how to treat the sloughing wound with tissue ischaemia in a sick or poorly nourished patient. These infected wounds are difficult to debride without causing further tissue loss and/ or the need for amputation¹⁹. Maggots have been known for centuries to help heal wounds. Many military surgeons noted that soldiers whose wounds became infested with maggots did better --- and had a much lower mortality rate --- than did soldiers with similar wounds not infested. Maggots, once considered an obsolete therapeutic modality, have been found to be a useful addition to the armamentarium of the foot and ankle specialist². Maggot therapy is a relatively rapid and effective treatment, particularly in large necrotic wounds requiring debridement and resistant to conventional treatment and conservative surgical intervention¹. Advantages of maggot therapy includes stimulation of epithelialization in clean but non-healing wounds; disinfection, odour, and drainage control; determination of tissue viability; debridement of acute burns, necrotic tumours, and ischemic ulcers; and debridement of unusual sites (i.e. glans penis, joints, pleural space, and peritoneal cavity)³. This review is therefore aimed at outlining the clinical application of maggots in managing difficult wounds and to bring out the significance of these “young insects” in wound management. This is also a very important subject especially in the poor developing world where the cost of surgical debridement may keep patients in bed

for months. A cheaper and safer alternative like MDT is therefore a much more needed option to consider in wound care in developing countries. Sterile larvae of the common green bottle, *Lucilia sericata*, have been shown to be a highly cost-effective alternative to conventional treatments for the debridement and cleansing of all types of chronic wounds.

Historical background: During the 1930s, maggot debridement therapy (MDT) was routinely used in hundreds of hospitals around the world for treating bone and soft-tissue infections⁴. In 1942 a grievously wounded soldier was forsaken in the "No Man's Land" for five days. However he totally recovered as his wound had been overrun by maggots and a decision was made by H. Fruchaud to apply maggots to all infected wounds⁵.

With the introduction of antibiotics and other improvements in wound care, by the 1960s maggot therapy was used only as salvage therapy for the most serious wounds⁶. Maggot Debridement Therapy (MDT) is the medical use of live maggots (fly larvae) for treating non-healing wounds. 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 2006⁷.

The world war waged in the first half of the 20th century brought devastating and great suffering to mankind. War injuries often resulted in incurable infections of the bone. In many cases, limb amputation was the only recourse for their survival. This dark picture was slightly brightened by countless reports of soldiers whose maggot-laden wounds were free of infection. Soon it became clear that the maggots were responsible for saving many lives and limbs. Thus maggot debridement therapy was born⁸. It is now a universally acknowledged fact that maggot therapy can be used successfully to treat chronic, long-standing, infected wounds, which have previously failed to respond to conventional treatment⁹. The use of maggot therapy is

experiencing a revival in the treatment of problem wounds¹⁰.

LIFE CYCLE OF THE MAGGOT FLIES: Maggots, by definition, are fly larvae, just as caterpillars are butterfly or moth larvae. Blow flies and bottle flies can breed on dead rodents and birds in attics or wall voids of houses. They are sometimes known as blue or green bottle flies. They usually breed in meat scraps, animal excrement, and decaying animal matter around houses. The adult flies are quite active inside and are strongly attracted to light. The mature larvae are often a problem when they migrate from breeding areas to pupate. Blow flies usually lay eggs on dead animals or decaying meat. Garbage cans have been known to produce 30,000 blow flies in one week. The life cycle usually lasts 9-21 days from egg to adult. Blow fly larvae (maggots) develop rapidly in warm weather, and maggots often reach their full size on the second or third day after hatching. There are thousands of species of flies, each with its own habits and life cycle. *Phaenicia sericata* (green blow fly) larvae is used in clinical work, since this species has been used successfully in maggot therapy for many decades.

Although treatment with maggot is overall cheaper and safe, production of larvae need a well equipped laboratory and for this purpose. This is often unavailable in developing countries where this therapy is likely to be of great assistance to patients. Larvae are raised in the laboratory. Fly larvae ingest contaminated foods from their immediate surrounding soon after hatching and can no longer be sterilized. However the embryo inside the blowfly egg is sterile and the membrane (chorion) enveloping the egg is extremely resistant. Therefore fly eggs can be sterilized by disinfecting the surface of the eggs and allowing the sterile larvae to hatch in a sterile container with sterile culture media. The optimal disinfectant should have high antibacterial potency but a low level of egg toxicity. A microbiological laboratory must routinely test the sterilized eggs and hatched larvae for sterility within 24-48 hours. Until the microbiology results are available the eggs are

kept in a refrigerator at low temp to slow the further development of the larvae and to increase their shelf life. After hatching the disinfected maggot will survive for 3-7days depending primarily on the adequacy of air moisture temperature and food. Transportation often shortens their life span because of increased pressure or extremes temperature or insufficient oxygen or nutrients⁸.

A drawing of the life cycle of this fly appears in Figure 1.

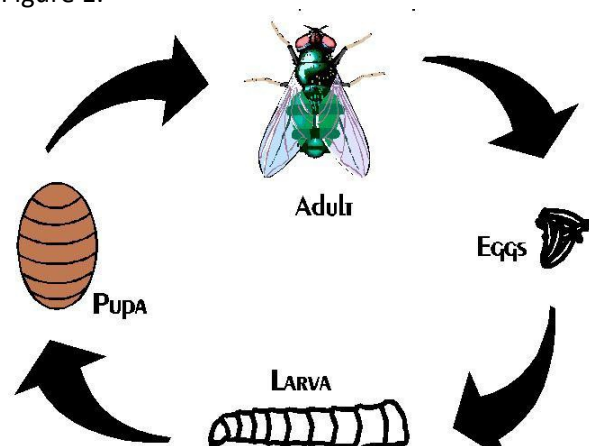


Figure 1: Blow Fly life cycle⁴

Preparation for maggot therapy

The flies most often used in larval therapy are the facultative calliphorids, with the greenbottle blowfly (*Lucilia sericata*) being the most widely used species¹¹. Sterile larvae of the common

green- bottle, *Lucilia sericata*, have been shown to be a highly cost-effective alternative to conventional treatments for the debridement and cleansing of all types of chronic wounds.

Sterilization techniques used to prepare maggots include utilization of ultra-violet C (UVC) and maggot sterilisation with disinfectants. Egg sterilisation with UVC had the lowest hatching rate (16+/-0.00%) while egg sterilization with disinfectants showed high hatching rate (36.67+/-4.41%) but low maggot survival rate (31.67+/-1.67%). Sterilization of the maggots has been found to be most suitable¹². Maggots are less commonly used in traumatic injuries, although in these wounds their remarkable wound cleansing properties

could be of considerable value¹³. Up to 1000 maggots are introduced in the wound and left for 1 to 3 days. MDT could be used for any kind of purulent, sloughy wound on the skin, independent of the underlying diseases or the location on the body for ambulatory as well as for hospitalized patients¹⁴.

Clinical applications of maggot debridement therapy

When modern medicine fails, it is often useful to draw ideas from ancient treatments. Debridement is an essential component of wound care as the presence of devitalised tissue can impede the healing process¹⁵. The therapeutic use of fly larvae to debride necrotic tissue, also known as larval therapy, maggot debridement therapy or biosurgery, dates back to the beginning of civilization¹¹. The medicinal use of maggots for the biological debridement of chronic wounds is increasing around the world, due to its efficacy, safety and simplicity

¹⁶

The most common indications for using maggot therapy were to effect debridement and control infection, especially if the wound failed to respond to conventional medical and/or surgical therapy¹⁷. The nature of the antibacterial materials extracted from maggots not only indicates their ability to ingest the necrotic tissue on the wound, but also their

¹⁸

potential significance in wound healing With

Maggot Debridement Therapy, the offensive odour emanating from the necrotic tissue and the intense pain accompanying the wound decrease significantly¹⁴.

The commonest application of maggots is once or twice, and since one set of maggots are in place for 3-4 days, this means that for many patients, the treatment was complete in just 1 week or a little over¹⁹. Up to 1000 maggots are introduced in the wound and left for 1 to 3 days¹⁴. A higher number of maggots are needed not only for a larger wound or a wound with a higher percentage covered with slough, but also for a wound infected with gram-negative bacteria²⁰. Maggots are either allowed as free range in the wound or contained. With the free-

range technique, the mean number of maggot applications and the total number of maggots per treatment have been found to be significantly lower than with the contained application technique²¹.

The mechanisms by which maggots enhance tissue formation within wounds may be via the promotion of fibroblast motility, acceleration of extracellular matrix remodeling and coordination of cellular responses²². Maggots cause wounds to become alkaline and in this way diminish growth of pathogenic bacteria²³. Maggot Debridement Therapy has led to massive growth of granulation tissue and microbiological cleaning of the wounds²⁴. The beneficial effects of maggots on chronic wounds may be explained in part by inhibition of multiple pro-inflammatory responses of activated neutrophils by Excretion/Secretion (ES)²⁵. Cambal *et al.* observed that maggot therapy was more effective and efficient in debriding non-healing leg ulcers than a conservative treatment²⁴ and another report²⁶ also reveals that maggot treated wounds follow the normal phases of wound healing. A single maggot has been found to be capable of debriding approximately 0.15 g of dead tissue per day with application intervals of 4 days being more appropriate than those of 3 days¹⁰. The nature of the antibacterial materials extracted from maggots not only indicates their ability to ingest the necrotic tissue on the wound, but also their potential significance in wound healing¹⁸. Maggot Debridement Therapy has been found to be of great help in the management of many types of wounds. Maggot therapy was more effective and efficient in debriding chronic pressure ulcers than were the conventional treatments²⁷. The potential benefit of Maggot therapy has been highlighted in diabetic wound care in developing countries and has been proved to be a rapid, simple and efficient method of treating the ulcers²⁸. Maggot debridement therapy reduces short-term morbidity in non-ambulatory patients with diabetic foot wounds²⁹. Successful maggot treatment of chronic foot ulcer has been

reported³⁰ with its effectiveness in many chronic wound in Spain³¹. Maggot therapy has been used in locations--e. g. perineal--which are difficult to provide with hydrocolloid wound dressings. In Gynaecological practice maggots can clear wounds of staphylococci and streptococci populations, are successful in wounds caused by radiation therapy and can be used after chemotherapy³². Maggot therapy has also been successfully used in the debridement of a severely infected wound after forearm replantations³³ as well as in necrotizing fascitis³⁴. Fewer amputation and more antibiotic free days were observed in "lower-extremity hospice" wound care with the use of maggots³⁵. In certain clinical situations, such as eliminating methicillin-resistant *Staphylococcus aureus*, larval therapy is considered to be a proven alternative in modern wound management³⁶. Presurgical MDT was effective in preparing the wound bed for surgical closure, without increased risk of post surgical wound infection³⁷.

Complications of maggot therapy.

Patients readily accepted maggot therapy, and adverse events are uncommon²⁶. Noted drawbacks include the time and effort needed to train personnel and convince administrators of the need for treatment³. Although pain has been a topic of some controversy in the use of MDT (and this occurs as a result of crawling of maggot over the wound), a study³⁸ has shown that 78% of patients pain can be adequately treated with analgesic therapy and where associated pain is unmanageable in the outpatient department, hospital admission, using the contained method of application or, in the worst case scenario, cessation of treatment has been suggested. A standardised but individually tailored pain management protocol is mandatory. Most of the few patients who had increased pain while on MDT in a study wanted to continue the treatment because of subjective and objective visual improvement in wound debridement³⁹. Tickling irritation, rejection due to some psychological disturbance by some patients,

are some of the draw backs of this method of wound care.

CONCLUSION

Maggot therapy is a cheap, safe and highly effective treatment of wounds and patients' acceptance is very high and psychological stress has been rare¹⁵. Although initially repellent, larval therapy is acceptable once treatment starts. The nurse-patient relationship was a significant factor in acceptance, along with autonomy and informed choice⁴⁰. Maggot Debridement Therapy is therefore a method of wound care that should have relevance in developing and poor countries where patients present with severe and neglected chronic wounds which often result in amputation. This cheap method of wound debridement is also very relevant as most of the patients are poor and tend to have prolonged wound dressing period with absenteeism in their various jobs and attendant economic loss.

References

1. Wollina U, Karte K, Herold C, Looks A. Biosurgery in wound healing - the renaissance of maggot therapy. *Journal of the European Academy of Dermatology and Venereology*. 2000; 14 (4), 285–289.
2. Armstrong D G., Mossel J , Short B, et al. Maggot Debridement Therapy A Primer. *Journal of the American Podiatric Medical Association*. 2002;92(7): 398-401.
3. Sherman RA, Shapiro CE, Yang RM. Maggot therapy for problematic wounds: uncommon and off-label applications. *Adv Skin Wound Care*. 2007; 20(11):602-10.
4. Sherman RA: Maggot therapy in modern medicine. *Maggot Therapy for Treating Diabetic Foot Ulcers Unresponsive to Conventional Therapy*. *Infect Med* 1998; 15:651–656,
5. Mawas E. Maggots and man. *Hist Sci Med*. 2004; 38(1):81-7.
6. Sherman RA. Maggot Therapy for Treating Diabetic Foot Ulcers Unresponsive to Conventional Therapy *Diabetes Care*. 2003; 26:446-451.
7. Sherman RA. Maggot Debridement Therapy (MDT). Wound care Information Network. <http://medicaledu.com/maggots.htm>. Assesses 12/11/2008.
8. Fleischmann W. Grassberger M.; Sherman R. *Maggot Therapy- A Hand book of maggot Assisted wound healing*. Thieme Stuttgart. New York. 2003.
9. Nigam Y, Bexfield A, Thomas S, Ratcliffe NA. *Maggot Therapy: The Science and Implication for CAM Part I-History and Bacterial Resistance*. *Evid Based Complement Alternat Med*. 2006; 3(2):223-7.
10. Blake FA, Abromeit N, Bubenheim M. et al. The biosurgical wound debridement: experimental investigation of efficiency and practicability. *Wound Repair Regen*. 2007; 15(5):756-61.
11. Whitaker IS, Twine C, Whitaker MJ. et al. Larval therapy from antiquity to the present day: mechanisms of action, clinical applications and future potential. *Postgrad Med J*. 2007; 83(980):409-13.
12. Mohd Masri S, Nazni WA, Lee HL et al. Sterilisation of *Lucilia cuprina* Wiedemann maggots used in therapy of intractable wounds. *Trop Biomed*. 2005; 22(2):185-9.
13. James C. Use of sterile maggots in an unusual trauma injury. *Br J Nurs*. 2007; 16(6):S30-1.
14. Mumcuoglu, Kosta Y. Clinical Applications for Maggots in Wound Care. *American Journal of Clinical Dermatology*. 2001; 2(4):219-227.
15. Parnés A, Lagan KM. Larval therapy in wound management: a review. *Int J Clin Pract*. 2007 Mar;61(3):488-93.
16. Tanyuksel M. Araz E. Dundar K. et al. Maggot debridement therapy in the treatment of chronic wounds in a military hospital setup in Turkey. *Dermatology*. 2005;210(2):115-8.
17. Sherman RA, Stevens H, Ng D, Iversen E. Treating wounds in small animals with maggot debridement therapy: a survey of practitioners. *Vet J*. 2007 Jan;173(1):138-43.
18. Huberman L, Gollop N, Mumcuoglu KY. Antibacterial properties of whole body extracts and haemolymph of *Lucilia sericata*. maggots. *J Wound Care*. 2007;16 (3):123-7.
19. Rankin K. *Surgery Review*. 2007; 30(1): 30-31.
20. Steenvoorde P, Jukema G.N. The antimicrobial activity of maggots: in-vivo results. *J Tissue Viability*. 2004 Jul;14(3):97-101.
21. Steenvoorde P, Jacobi CE, Oskam J. Maggot debridement therapy: free-range or contained? An in-vivo study. *Adv Skin Wound Care*. 2005;18(8):430 - 5.

22. Horobin AJ, Shakesheff KM, Pritchard DI. Promotion of human dermal fibroblast migration, matrix remodelling and modification of fibroblast morphology within a novel 3D model by *Lucilia sericata* larval secretions. *J Invest Dermatol.* 2006;126(6):1410-8.
23. Baer S W. The treatment of chronic osteomyelitis with the maggot(Larva of the blofly). *Journal of Bone and Joint Surgery,* 1931;13:438-475.
24. Cambal M. Labas P. Kozanek M. et al. Maggot debridement therapy. *Bratisl Lek Listy.* 2006;107(11-12):442-4.
25. van der Plas MJ. van der Does AM. Baldry M. et al. Maggot excretions/secretions inhibit multiple neutrophil pro-inflammatory responses. *Microbes Infect.* 2007; 9(4):507-14.
26. Steenvoorde P, Calame JJ, Oskam J. Maggot-treated wounds follow normal wound healing phases. *Int J Dermatol.* 2006;45(12):1477-9.
27. Sherman RA. Maggot versus conservative debridement therapy for the treatment of pressure ulcers. *Wound Repair Regen.* 2002; 10(4), 208–214.
28. Tantawi TI. Gohar YM. Kotb MM. et al. Clinical and microbiological efficacy of MDT in the treatment of diabetic foot ulcers. *J Wound Care.* 2007;16 (9):379-83.
29. Armstrong DG. Salas P. Short B. et al. Maggot therapy in "lower-extremity hospice" wound care: fewer amputations and more antibiotic-free days. *J Am Podiatr Med Assoc.* 2005; 95(3):254-7.
30. Brin YS. Mumcuoglu KY. Massarwe S. et al. Chronic foot ulcer management using maggot debridement and topical negative pressure therapy. *J Wound Care.* 2007;16 (3):111-3.
31. Leyva-Moral JM. The effectiveness of larval therapy in the debridement of chronic wounds; a bibliographical review. *Rev Enferm.* 2007; 30(1):10-4.
32. Brüggmann D. Tinneberg HR. Zygmunt MT. Maggot therapy in gynecology. *Zentralbl Gynakol.* 2006;128(5):261-5.
33. Wang J. Wang S. Zhao G. et al. Treatment of infected wounds with maggot therapy after replantation. *J Reconstr Microsurg.* 2006;22(4):277-80.
34. Rozeboom AL. Steenvoorde P. Hartgrink HH. Et al. Necrotising fasciitis of the leg following a simple pelvic fracture: case report and literature review. *J Wound Care.* 2006;15(3):117-20.
35. Armstrong DG, Salas P, Short B. et al. Maggot therapy in "lower-extremity hospice" wound care: fewer amputations and more antibiotic-free days. *J Am Podiatr Med Assoc.* 2005;95(3):254-7.
36. Richardson M. The benefits of larval therapy in wound care. *Nurs Stand.* 2004;19(7):70, 72, 74 passim.
37. Sherman RA. Shimoda KJ. Presurgical maggot debridement of soft tissue wounds is associated with decreased rates of postoperative infection. *Clin Infect Dis.* 2004;39(7):1067-70.
38. Steenvoorde P. Budding T. Oskam J. Determining pain levels in patients treated with maggot debridement therapy. *J Wound Care.* 2005; 14(10):485-8.
39. Wolff H. Hansson C. Larval therapy--an effective method of ulcer debridement. *Clin Exp Dermatol.* 2003; 28(2):134-7.
40. Kitching M. Patients' perceptions and experiences of larval therapy. *J Wound Care.* 2004; 13(1):25-9.