What is Larval Debridement Therapy (LDT)?

The term 'Larval Debridement Therapy' describes the use of maggots, precisely the larvae of the green bottle blowfly *Lucilia sericata*, for the removal of dead tissue and slough from the wound surface (debridement). Because of its selectivity for dead tissue, it is also known as biosurgery. Larvae of this necrophagous species have been used since ancient times. Today LDT is increasingly used in response to the rising challenges posed by multi-resistant bacteria, which may be present in chronic wounds (Thomas, 2010; Fleischmann et al, 2004).

When should LDT be used?

Normal 'acute' wound healing follows an ordered sequence of cellular and biochemical events, with wound closure achieved within a few weeks. In chronic wounds, this ordered sequence of events is disturbed. Possible causes, or barriers to healing, may include the presence of slough or necrosis on the wound surface, infection, prolonged inflammation, and an imbalance of moisture or the presence of harmful chronic wound exudate.

Wound bed preparation and TIME

Wound bed preparation (WBP), along with TIME, was developed to offer clinicians a structured approach to wound assessment and to provide the basis for the removal of barriers to healing (Schultz et al, 2003). The acronym 'TIME' stands for **T**issue (non-viable), **I**nfection, **M**oisture imbalance, and wound **E**dge (not migrating).

When following the TIME concept, the removal of dead or devitalised tissue (debridement), is considered the necessary first step.

Debridement using LDT is achieved by the action of proteolytic enzymes, which are secreted by larvae (Chambers et al, 2003). These enzymes liquefy proteinaceous material on the wound surface, which is subsequently sucked up by the larvae as nutrition. The action of larval enzymes is restricted to dead tissue; living tissue in the wound bed, including granulation tissue, is unaffected. Bacteria contained in this material are also taken up by the larvae. The antibacterial effect of LDT is enhanced by the secretion of bactericidal factors, which consist of small, heat-stable peptides (Bexfield et al, 2008; Cerovsky et al, 2010). In addition, larval secretions can prevent the formation of and reduce preformed biofilms (Harris, 2009; Cazander et al, 2009).

Remodelling and re-epithelialisation is also enhanced by the proteolytic enzymes contained in larval secretions, which support the movement of fibroblasts and keratinocytes necessary for tissue repair (Horobin et al, 2006).

Clinical evidence and cost-effectiveness of LDT

While recent clinical studies have proven the debridement efficacy of LDT (Dumville et al, 2009; Oplatelová et al, 2011), the antibacterial, wound healing and anti-inflammatory effects are based on extensive clinical experience (Gottrup and Jørgensen 2011; Gilead et al, 2012). There are, however, convincing biochemical studies available, which describe the modes of action of LDT and thus support the clinical observations.

Although carrying out well-controlled, blinded studies with chronic wound patients can be difficult, attempts have been made to demonstrate the cost-effectiveness of LDT (Thomas, 2006). A recent study has concluded that LDT is cost-effective when compared to other mainstream debridement interventions including surgical, sharp, mechanical and autolytic debridement methods (Phillips, report in progress).

Before and after LDT (1 application) in a patient with donor graft site wound

LDT modes of application

LDT can be achieved by free range larvae or by bagged larvae. The larvae can be left on the wound for up to 4 days. Depending on the amount of dead tissue, a clean wound should be achieved after 1 to 3 applications.

Free range larvae: A dressing or 'cage' is put in place to retain the larvae. Although more time consuming, this may be the most suitable application for irregularly shaped wounds, or wounds with undermining edges and tunnels.

BioBags: Using larvae contained in a bag-like device makes the application and removal of larvae significantly easier for the clinician. BioBags are available in different sizes and consist of a polyester net and a cube of PVA foam that acts as a spacer. BioBags are placed on the wound areas that need to be debrided and covered with an appropriate secondary dressing.

Investigations have demonstrated that free range and bagged larvae are equally efficacious in terms of debriding the wound (Blake et al, 2007).

References

Andersen A et al. 2010. A novel approach to the antimicrobial activity of maggot debridement therapy. J Antimicrob Chemother 65(8); 1646-54.

Bexfield A et al. 2008. The antibacterial activity against MRSA strains and other bacteria of a <500 Da fraction from maggot excretions/secretions of Lucilia sericata (Diptera: Calliphoridae). Microbes and Infection 10 (4); 325-33.

Blake FAS et al. 2007.The biosurgical wound debridement: Experimental investigation of efficiency and practicability. Wound Repair Regen 15; 756-61.

Cazander G et al. 2009. Maggot excretions inhibit biofilm formation on biomaterials. Clin Orthop Rel Research 468(2); 2789-96.

Cazander G et al. 2012. Anti-inflammatory actions of maggot secretions. Presentation. 15th EPUAP Annual Meeting, Cardiff.

Cerovsky V et al. 2010. Lucifensin, the long-sought antimicrobial factor of medicinal maggots of the blowfly Lucilia sericata. Cell Mol Sci 67(3); 455-66.

Chambers L et al. 2003. Degradation of extracellular matrix components by defined proteinases from the greenbottle larva Lucilia sericata used for the clinical debridement of non-healing wounds. Br J Dermatol 148; 14–23.

Dumville JC et al. 2009. VenUS II: a randomised controlled trial of larval therapy in the mangement of leg ulcers. Health Technol Assess 13(55); 1-182.

EWMA Document. Debridement (2013). Available from: www.ewma.org

Fleischmann W et al. 2004. Maggot Therapy. A Handbook of Maggot-Assisted Wound Healing. Thieme 2004. ISBN 3-13-136811-X (GTV)

Gilead L et al. 2012. The use of maggot debridement therapy in the treatment of chronic wounds in hospitalised and ambulatory patients. J Wound Care 21(2); 78, 80, 82-85.

Gottrup F, Jørgensen B. 2012. Maggot debridement: an alternative method for debridement. Eplasty 11:e33.

Harris LG et al. 2009. Disruption of S.epidermidis biofilms by medicinal maggot Licilia sericata exretions/secretions. Int J Artif Organs 32(9): 55-64.

Horobin AJ et al. 2006. Promotion of human dermal fibroblast migration, matrix remodelling and modification of fibroblast morphology with a novel 3D model by Lucilia sericata larval sections. J Invest Dermatol 126(6): 1410-8.

Oplatelová et al, 2011. Maggot therapy for wound debridement. A randomised multicenter trial. Arch Dermatol 148(4): 432-8.

Schultz GS, et al. 2003. Wound bed preparation. A systematic approach to wound management. Wound Repair Regen 11(Suppl 1): S1-8.

Thomas S. 2006. The cost of managing chronic wounds in the UK, with particular emphasis on maggot debridement therapy. J Wound Care 15(10): 137-41.

Thomas S. 2010. Maggot therapy. In: Thomas S (ed). Surgical Dressings and Wound Management. Medetec Publications. 563-632.

Wounds UK. 2013. Effective debridement in a changing UK. A consensus. Available from: www.wounds-uk.com

WHY CHOOSE LARVAL DEBRIDEMENT THERAPY?

Benefit of LDT	Significance to clinical practice
Rapid debridement of dead and devitalised tissue	By removing dead and devitalised tissue from the wound bed rapidly larvae can assist in progressing wounds towards healing (Gottrup and Jørgensen, 2011). This can benefit diagnosis, reduce nursing hours and have a positive impact on patient quality of life.
Selectively debrides only dead and devitalised tissue	The secretions excreted by larvae only impact on dead tissue leaving any healthy tissue underneath undamaged. This ensures that there will be no trauma to the wound bed and makes larvae ideal for use around microstructures (Gottrup and Jørgensen, 2011; Fleischmann et al, 2004).
Larval secretions are proven to have antimicrobial and biofilm disrupting properties *in vitro*	A high bacterial burden and the presence of biofilms can have a detrimental effect on wound healing and patient quality of life. By reducing levels of bacteria (Andersen et al, 2010; Bexfield et al, 2008; Cerovsky et al, 2010) and disrupting biofilms (Harris, 2009; Cazander et al, 2009) it is likely that a wound will progress faster, odour levels will reduce and less tissue will become devitalised.
Clinically cost effective when compared to other mainstream debridement methods	All treatment decisions are made with the impact of cost as a factor that has to be considered. The on-going work by Professor Ceri Phillips and the Swansea Centre for Health Economics at Swansea University into the Clinical Efficacy and Cost-effectiveness of Larval Therapy in Wound Debridement has demonstrated that LDT can be used with confidence in the knowledge that important funds are being used effectively (Phillips, report in progress).
Simple application means that the product can be applied by any health care professional	Larvae come in a range of sizes and formats and are very simple to apply; they are also supplied with step by step pictorial instructions. This ensures that specialist clinicians are not required to be present during application and removal (Wounds UK, 2013; EWMA, 2013).
A gentle non-invasive procedure that can be used on the most vulnerable patients	Larvae are suitable for use on a wide range on patients, including those considered too fragile for surgery (Gottrup and Jørgensen, 2011; Gilead et al, 2012)
A natural process	Larvae are non-cytotoxic and so by using them there is a reduced risk of adverse reactions. Larvae also reduce the opportunity for resistant pathogens to develop within a wound (Bexfield et al, 2008).

Before and after LDT (3 applications) in a patient with a diabetic foot ulcer

Note: The eschar was first hydrated with a gel prior to application of the larvae

For further information on Larval Debridement Therapy:

BioMonde® is the only provider of bagged larvae in Europe.
To contact a member of the team:
Tel: 0845 230 1810
Email: info@biomonde.com
Web: www.biomonde.com