



ORIGINAL ARTICLE

Maggot therapy for chronic ulcer: A retrospective cohort and a meta-analysis



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Summary *Background/Objective:* Maggot wound therapy (MWT) has been used in various wounds including diabetic foot ulcers, venous leg ulcers, pressure ulcers, and acute surgical wounds. However, the efficacy of MWT therapy has been controversial. We therefore conducted a cohort study and a meta-analysis to assess MWT effects.

Methods: A retrospective cohort study was performed in diabetic foot ulcer (DFU) patients who were treated with MWT or conventional wound therapy (CWT) in Thailand. The Kaplan-Meier curve was applied to estimate the healing probability. A meta-analysis was performed to pool our study with four previous cohort studies identified from Medline and Scopus.

Results: The estimated incidence of wound healing was 5.7/100 (95% CI: 4.49, 7.32) patients-week, and the median time to healing was 14 weeks. The hazard ratio (HR) of wound healing was 7.87 times significantly higher in the MWT than the CWT ($p < 0.001$) after adjusting for duration and size of ulcers, ankle brachial index (ABI), and glycated hemoglobin (HbA1c). Meta-analysis was applied and suggested that the treatment effects were moderately heterogeneous {Chi-square = 6.18 [degrees of freedom (d.f.) = 4]; $p = 0.186$; $I^2 = 35.2\%$ }, with the pooled risk ratio (RR) of 1.77 [95% confidence intervals (CI) = 1.01, 3.11], i.e., the chance of wound healing was 20% significantly higher with MWT than CWT. The average costs of

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treatment in patients with DFU were lower in the MWT group than in the CWT group, with medians of US\$292.82 and US\$490, respectively.

Conclusion: Our evidence suggests that MWT is significantly better for wound healing and more cost-effective than CWT. An updated meta-analysis or large scale randomized controlled trial (RCT) is required to confirm this effect.

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1. Background

One of the important aspects of wound management, especially in intractable wounds, is removal of necrotic tissue, which is known as debridement. The use of maggots for this purpose has been claimed to be an efficacious method,^{1,2} that stimulates wound healing,^{3,4} reduces the bacterial load,⁵ and eradicates methicillin resistant *Staphylococcus aureus in vitro*.^{6,7} Maggot wound therapy (MWT) has been applied in various settings, e.g., diabetic foot ulcers (DFU),^{8,9} peripheral arterial diseases,¹⁰ venous leg ulcers,¹¹ pressure ulcers,¹² and acute surgical wounds.^{13,14}

The use of MWT is increasing as a reflection of the increasing acceptance since approval by the Food and Drug Administration. The recent enthusiasm for MWT is supported and calls for public attention. However, the results of MWT treatment are still controversial.¹⁰ A randomized controlled trial (RCT)¹⁵ could not demonstrate differences in the rate of wound healing and healing time between MWT and standard treatment in venous leg ulcers, although MWT did reduce the time to debridement by approximately 2 days, but with significantly higher pain scores. The cost-effectiveness of MWT has been reported in some studies with conflicting results^{3–5}; MWT was initially shown to have lower costs of treatment and require fewer visits, but these could not be confirmed in a recent RCT study.¹⁶

We, therefore, performed a retrospective cohort study and follow-up meta-analysis of comparative studies to evaluate wound healing outcomes with MWT compared with conventional wound therapy (CWT).

2. Materials and methods

2.1. Cohort study

A retrospective cohort study was performed by reviewing the medical records of diabetic DFU patients who were treated at Bang Yai Hospital, Nonthaburi Province, Thailand from January 2008 to December 2009. Bang Yai hospital is a 30-bed hospital that provides primary care services. Patients who met the following criteria were included in the study: (1) presence of a single wound of the foot; (2) ability to walk without the use of a wheelchair or other assistive device; (3) data were available for at least 6 months of follow-up; and (4) no gangrenous wounds, necrotizing fasciitis, abscess, or osteomyelitis present. Patients were assigned by physicians who were well trained in chronic

wound care, to receive MWT or CWT at the out-patient clinic or in-patient wards, based on physician judgment.

Maggots were prepared by Biomonde Thailand Co. Ltd., Bangkok, Thailand using a standard biological room. Briefly, adult flies were kept in a temperature-controlled room (25 °C) with constant light, air, and humidity (33%). After oviposition was documented, the eggs were transferred to a clean room and they were fed with sheep blood agar until they reached the post-feeding stage.^{17,18} Then, maggots were applied to the wounds in a bio-bag, with an average of eight maggots/cm² of wound surface.¹⁹ The wound was covered with wet light gauze, and the entire foot was loosely bandaged. The median number of applications of maggots was 8.25 [standard deviation (SD) = 5–13] times/patient. For the control group, the wound was dressed with normal saline or hydrogel and debridement was performed as judged by the treating physician. The wounds were debrided with a median of 8.79 (SD = 5–14) times/patient. The wound was evaluated once/week by nurse practitioners and evaluated using digital photographic images. Patients were classified as having wound healing if their wounds had $\geq 95\%$ complete epithelial covering in the absence of a scab, and the wounds were suitable for split skin grafting, flap coverage, or self-healing.²⁰ Healing time was defined as the time from treatment initiation to wound healing. Patients were followed up from treatment initiation until the end of December 2009. The study was approved by the Institutional Review Board prior to conducting the study and all participants had given informed consent.

3. Meta-analysis

Studies were identified using PubMed and Scopus search engines from January 1946 to September 15, 2011. The search strategy is described in [Appendix 1](#).

3.1. Inclusion criteria

Comparative studies of MWT and CWT were included in the review if they met with the following criteria: patients aged ≥ 18 years and compared wound healing rate or wound healing time between groups. The reference lists of all relevant studies were also reviewed. If studies were duplicated, the one with the most complete data was chosen. For studies which reported insufficient data, the corresponding authors were contacted and invited to provide more information. Two attempts were made to contact

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