

Conference Paper

Using Maggots as Biodebridement in Chronic Infection Wounds to Increase Wound Healing and Cost Effectiveness: A Review

Henik Tri Rahayu*, Faqih Ruhyanudin

Department of Nursing, Health Science Faculty, University of Muhammadiyah Malang, Malang, Jawa Timur, Indonesia.

ORCID

Henik Tri Rahayu: <https://orcid.org/0000-0002-9623-771X>

Abstract.

Nurses working in the field of wound care are faced with chronic ulcers, infected wounds that may have stubborn necrosis, and slough that is very difficult to eliminate within the wound bed treated as devitalized tissue. The beneficial effects of maggots as biodebridement in the process of wound healing have been known for centuries. However, maggot debridement therapy (MDT) is new, and few healthcare services use it in Indonesia. Searching for supporting evidence is essential before applying this therapy more widely in the Indonesian healthcare community. The objective of this review was to identify, describe and assess the evidence regarding the effects of using maggots as biodebridement in chronically infected wounds to increase wound healing and cost-effectiveness. Six databases (Pubmed, Medline, CINAHL, OvidSP, NRC and Cochrane) were searched using a systematic strategy with the keywords larval therapy, maggot therapy, chronic wounds, leg ulcers, pressure ulcers, infected wound, debridement, wound healing, and cost-effectiveness, with language restriction to only articles published in English. Four out of the 834 total found studies were selected to be critically reviewed. Almost all of the studies favored MDT as a safe debridement method for its rapid granulation and complete debridement effects for chronic/infection wounds; only one study suggested that MDT had the same effect as conventional debridement. One study mentioned the disadvantages of using conventional/surgical debridement such as the risk of vessel and nerve breaks, lengthier hospital stay, and the need for antibiotics and analgesics. Based on the findings, it can be concluded that MDT is a safe, simple, effective, and cost-efficient treatment modality for chronic, intractable wounds for ambulatory and hospitalized patients. It can prevent the need for surgical debridement (operations) and amputations, and can reduce the use of antibiotics and decrease the length of hospitalization stay, thereby saving money. However, more high quality evidence supporting this treatment may still be needed.

Keywords: chronic wound, maggot debridement therapy, effectiveness, cost-efficient

Corresponding Author: Henik Tri Rahayu; email: trirahayu@umm.ac.id

Published 15 September 2022

Publishing services provided by Knowledge E

© Henik Tri Rahayu, Faqih Ruhyanudin. This article is distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the ICMEDH Conference Committee.

OPEN ACCESS

1. Introduction

Nurse professionals working in wound care face a continuing need to heal chronic ulcers, as these types of wounds do not follow the typical healing route (Enoch and Harding, 2003). Potential problems that arose from assessment cause barriers in the wound healing process, increasing the risk of infection, resulting in delayed healing and the possibility of a chronic wound. According to Davies, Turton [1], stubborn necrosis or slough is very difficult to eliminate within the wound bed as devitalized tissue. These conditions cause a dilemma that difficult to suitably assess an ulcer until the necessary debridement has taken place.

Wound debridement is defined as removing foreign material and contaminated dead tissue from (or adjacent to) a traumatic or infected lesion to expose healthy tissue. It may also include removing foreign material that has become embedded in the wound [2]. There is a discovery about using Maggot or larvae to debride chronic wounds called Maggot Debridement Therapy (MDT). MDT can be used to treat a variety of wounds, such as leg ulcers [3]; pressure ulcers [4]; diabetic foot [5]; traumatic wounds [6]; burns [7]; surgical wounds [8]; necrotic tumor [9]; and necrotizing fasciitis (10).

In chronic wounds, such as diabetic ulcers, pressure ulcers, venous and arterial ulcers, the indications for use could be the rapid debridement of necrotic and sloughy tissue or to eradicate problems associated with recurrent infections to aid the wound bed preparation process. The beneficial effects of maggots in the process of wound healing have been known for centuries. For the last 15 years, maggot debridement therapy (MDT) has been used in Europe and the United States clinical practices to treat various types of severely infected and necrotic wounds with successful healing results [2]. However, in Indonesia, MDT is still new therapy, and a minimal amount of healthcare services use it. Therefore, we need to search for evidence that supports it to apply this therapy in Indonesia's healthcare community. Based on that, this review study aims to identify, describe and assess the evidence regarding the effects of using Maggot as biodebridement in chronically infected wounds to increase wound healing and reach cost-effectiveness.

2. Methods

This study is a brief systematic review. We formulate a clinical question (in PICO format):”
In chronic/infection wounds (P), how does the Maggot debridement therapy/MDT (I)

compare with conventional therapy (C) increase the wound healing (O) in a fewer time (T)?

3. Searching Strategy

A search strategy was used to identify both empirical and theoretical literature using the keywords: larval therapy, maggot therapy, chronic wounds, leg ulcers, pressure ulcers, infected wounds, debridement, wound healing, and cost-effectiveness. Search strategy using advance search in Pubmed, Medline, CINAHL, OvidSP, Cochrane, and Nursing Reference Center (NRC). There were 834 papers found in this searching process, and only four articles include in this brief review after screening processes.

TABLE 1: PICOT searching strategy.

PICOT	Keywords /MesH	Database	Literatures
P: <i>In chronic/infection wounds</i>	Chronic wounds, infected wounds, leg ulcers, pressure ulcers	PubMed OvidSP Cochrane NRC CINAHL Medline	10 17 3 563 38 203
I: <i>Maggot debridement therapy/MDT</i>	Maggot therapy, larval therapy		
C: <i>conventional therapy</i>	Conventional therapy, debridement, surgical debridement		
O: <i>wound healing</i>	Wound healing		
T: <i>in a fewer time</i>	Cost-effectiveness		

These are the four chosen articles:

1. The use of maggot debridement therapy in the treatment of chronic wounds in hospitalized and ambulatory patients: Gilead, Mumcuoglu (11)
2. Maggot debridement therapy with *Lucilia cuprina*: a comparison with conventional debridement in diabetic foot ulcers: Paul, Ahmad (12)
3. Maggot versus conservative debridement therapy for the treatment of pressure ulcers: Sherman (13)
4. Debridement for surgical wounds (Review): Smith, Dryburgh (14)

4. Synthesizing the Evidence

We used the Rapid Critically appraisal (see detailed in Appendix 1) to evaluate the quality of the paper in order to be included in this review. We can conclude that almost

all articles have validity and reliability results. Table 1 (*Evaluation Table*) demonstrates the details of the review's results.

The measurements used to evaluate the effects of MDT in chronically wound were varied among studies. For instance, Geliad, L. et.al use a number of wounds (NW), duration of wound before using MDT (DW), number of treatment (NT) and treatment duration (TD). While Sherman, R.A uses ulcer length, width, circumference, surface area, relative and absolute surface area changes, necrotic tissue, and granulation tissue over time, and complete debridement and complete wound closure to evaluate the MDT use in chronic ulcers. Besides, Paul, A.G., et al. uses grade and subgrade of wound healings, then Smith F et al. include secondary indicators consisting of patient satisfaction, infection rate, length of hospital stays, and cost-effectiveness.

From all the evidence, one study found that MDT has no different effect to conventional debridement, and one study unclear explain it. However, almost all studies favor MDT as a debridement method. The studies found that MDT can promote complete debridement, decrease the size of wounds, and decrease necrotic tissues. In addition, one study suggests that the disadvantages of using conventional/surgical debridement include risk of vessels and nervous break, more length hospital stays, and need for antibiotics and analgesics. Besides, all studies show that MDT is safe and gives more benefits than conventional debridement, in which MDT has rapid granulation and complete debridement for chronic/infection wounds. Moreover, maggots for MDT can now easily find worldwide, including in Indonesia. Although some patients might still be uncomfortable using it in their wounds due to awful feelings, the proper explanation and education regarding the benefits and harms may be needed to convince them to accept it.

5. Conclusions

Using Maggot (MDT) for debridement is a safe, simple, effective, and cost-efficient treatment modality for chronic, intractable wounds in ambulatory and hospitalized patients. It can save surgical debridement (operations), amputations, and use of antibiotics, as well as long periods of hospitalization, which need more cost to treatments, however, maybe it needs more quality evidence that supports this treatment and we sure that this therapy safety to users and give benefits for our patients before we applied it in the clinical practices.

References

- [1] Davies CE, Turton G, Woolfrey G, Elley R, Taylor M. Exploring debridement options for chronic venous leg ulcers. *British Journal of Nursing*. 2005;14(7):393–397.
- [2] Gottrup F, Jørgensen B. Maggot debridement: An alternative method for debridement. *Eplasty*. 2011;11.
- [3] Courtenay M, Church J, Ryan T. Larva therapy in wound management. *Journal of the Royal Society of Medicine*. 2000;93(2):72–74.
- [4] Sherman RA, Wyle F, Vulpe M. Maggot therapy for treating pressure ulcers in spinal cord injury patients. *The Journal of Spinal Cord Medicine*. 1995;18(2):71–74.
- [5] Knowles A, Findlow A, Jackson N. Management of a diabetic foot ulcer using larval therapy. *Nursing Standard*. 2001;16(6):73–76.
- [6] Thomas S, Jones M, Shutler S, Jones S. Using larvae in modern wound management. *Journal of Wound Care*. 1996;5(2):60–69.
- [7] Namias N, Varela EJ, Varas RP, Quintana O, Ward GC. Biodebridement: A case report of maggot therapy for limb salvage after fourth-degree burns. *The Journal of Burn Care & Rehabilitation*. 2000;21(3):254–257.
- [8] Jones STM. Larval therapy. *Nursing Standard*. 2000;14(20):47.
- [9] Bunkis J, Gherini S, Walton RL. Maggot therapy revisited. *Western Journal of Medicine*. 1985;142(4):554.
- [10] Naik G, Harding KG. Maggot debridement therapy: the current perspectives. *Chronic Wound Care Management and Research*. 2017;4:121–128.
- [11] Gilead L, Mumcuoglu K, Ingber A. The use of maggot debridement therapy in the treatment of chronic wounds in hospitalised and ambulatory patients. *Journal of Wound Care*. 2012;21(2):78–85.
- [12] Paul AG, Ahmad NW, Lee H, Ariff AM, Saranam M, Naicker AS, et al. Maggot debridement therapy with *Lucilia cuprina*: A comparison with conventional debridement in diabetic foot ulcers. *International Wound Journal*. 2009;6(1):39–46.
- [13] Sherman RA. Maggot versus conservative debridement therapy for the treatment of pressure ulcers. *Wound Repair and Regeneration*. 2002;10(4):208–214.
- [14] Smith F, Dryburgh N, Donaldson J, Mitchell M. Debridement for surgical wounds. *Cochrane Database of Systematic Reviews*. 2013(9).

TABLE 2: Evaluation Table.

First Author (Year)	Conceptual Framework	Design/ Method	Sample/ Setting	Major Variable studied and their definition	Measurements	Data Analysis	Finding	Appraisal: Worth to practice
Geliad, L., et al., <i>Journal of wound care</i> ,21[2] February 2012, p.78-85	none	Case Study Purpose: To summarise the experience of the use of medicinal maggots for the debridement of necrotic chronic wounds	During 2009 723 wounds of 435 patients (180 females, 255 males) Setting: 16 depart. 261 Px: hospitalization 174 Px: ambulatory px 90,5%: wound located on the leg 48,0%: diabetic foot ulcers	IV: MDT using <i>Lucilia sericata</i> debridement process application of maggots : Direct Caged	NW: number of wound DW: duration wound before using MDT NT:number of treatment TD: treatment duration	Pivot table Mean Median percentage	NW: 1-25/px Mean:1,6;median:1 DW: 1-240 months Mean: 8,9 months; median: 4 months NT: 1-48 (mean: 2,93;median:2) TD: 1-81 days mean:4,65;median:3 Result: Complete deb: 357 (82.1%) Partial deb:73 (16.8%) Unchange:5 (1,1%)	Strengths: Identified variance in outcome definition and measurement Use a large sample size Quite clear explained about the treatment Conclusion: MDT promote debridement in chronic wounds Safe time dan cost-effectiveness Feasibility: MDT is reasonable to implement; simply used and give more benefits
Sherman,R.A. <i>Wound Repair and Regeneration</i> . 2002;10[4]:208-214	none	Cohort study Purpose: to define the efficacy and safety of maggots therapy	103 patients, 145 ulcers Setting: 50 ulcers of 61 Px treated by MDT 84 ulcers of 70 Px (17 Px: 1 ulcer with MDT, one ulcer not; 2Px only conventional treatment)	IV1: MDT use <i>Phaenicia sericata</i> conventional therapy IV2: MDT use <i>Phaenicia sericata</i> debridement process application of maggots: Caged hydrocolloid pad	Ulcer width, circumference, and surface area changes in relative and absolute surface area, necrotic tissue, granulation tissue over time complete debridement and complete wound closure WHR	Student's t-test Logistic regression Welch's t-test Mann-Whitney U-test Pearson's Chi-Square test ANOVA Paired t-test	Report pain: 2 Px both in MDT & conventional 1 Px MDT report anxiety 43 wounds – MDT 49 wounds – conventional 60% larger in MDT p=0.035 (often diabetes and higher-level albumin) 80% MDT: complete debrided < 5 weeks 52% non-MDT: incomplete debrided > 5 weeks (p=0.021) Feasibility: MDT is more effective than conventional therapy (p<0.001) Necrotic tissue decrease: MDT: F[1,5,49.1]=15.02, p<0.001 (3.7cm ² within 2 weeks) Conventional: no sign. Granulation: 49% vs 18%, p=0.002	Strength: Very detailed in measurement outcomes Method collection and data Conclusion: MDT promote complete debridement, decrease wound size, necrotic tissue, rapid growth granulation and tissue than conventional therapy Feasibility: MDT is more effective than conventional therapy and reasonable to use Risk/harm: benefits outweigh the risk

TABLE 2: (Continued).

First Author (Year)	Conceptual Framework	Design/ Method	Sample/ Setting	Major Variable studied and their definition	Measurements	Data Analysis	Finding	Appraisal: Worth to practice
Paul, A.G.,et al. <i>International Wound Journal</i> 2009;6[1]:39-46	none	Prospective Case-control study Purpose: to assess the effectiveness of MDT for the treatment of diabetic foot ulcers	From December 2005 to May 2007 (18 months) patients (18 males,11 females) and 30 control groups (conventional deb) Exclusion criteria: 1. Gangrenous wounds 2. Necrotising fasciitis 3. Abscesses 4. Wounds with exposed viable bones 5. Wounds with exposed tendons 6. Wounds that are profusely bleeding 7. Ischaemic wounds 8. Patients who have entomophobia	IV1: using <i>Lucilia sericata</i> MDT IV2: conventional debridement DV: wound healing application of maggots : Direct	Grade and subgrade: Healed Unhealed Other measurements 1. Hb count 2. Average blood sugars 3. Ankle-brachial systolic index 4. Serum albumin 5. White cell count 6. Neuropathy – tested using a 10 g Semme's monofilament 7. Age 8. Wound swab before treatment 9. Number of debridements 10. Length of ward stay	Mean Range The exact Fisher's test Student's t-test	29 Px wounds were healed, 11 were unhealed, and four were classified under others. 30 Px conventional debridement: 18 wounds healed, 11 unhealed, and one classified under others no significant difference in outcome between the two groups only length of stay have significantly different between 2 groups	Strength: Have clearly control groups between two groups Detailed outcomes measurements Weaknesses: Result: no significant difference between two groups Limited study (Many exclusion criteria) Conclusion: Although no significant difference outcomes between the two groups, MBD has the advantage of a shorter length of stay Feasibility: MDT can be considered use as alternative debridement

TABLE 2: (Continued).

<p>Smith F, et al. <i>Cochrane Database Syst Rev</i> 2011;5: CD006214</p>	<p>none</p>	<p>SR (Cochrane review) purpose: effect of different debridement methods on the rate of debridement and healing of surgical wounds. Searched six databases from 2007-2011 included RCT</p>	<p>N= 5 studies No restrictions which respect to language, date of publication, or setting</p>	<p>Primary: Time to complete debridement and healed proportion of wounds wholly debrided and healed. reduction rate in wound size Secondary: patient satisfaction infection rate length of hospital stay; cost-effectiveness Adverse events</p>	<p>Risk of bias Heterogeneity assessment: Cochrane Collaboration tool</p>	<p>1. poor quality of the trials; 2. small sample sizes; 3. limited range of treatments; 4. different control groups for each trial 5. lack of replication studies; and 6. inappropriate statistical analysis (time to event data not being analyzed as such)</p>	<p>Weakness: No data analysis (forest plot) Much heterogeneity of the study</p>
---	-------------	--	--	---	---	---	---

6. Appendix 1

Critical Appraisal of the Evidences

Step 1: Evaluating the Validity

Evidence Type: Case/ Case control study

TABLE 3

Questions	Geliad, L.,et.al	Paul, A.G.,et al.
How were the cases obtained?	Participants from units of the Hadassah Hospital in Jerusalem, Israel No exclusion criteria but clearly explain about the study	Participants from the orthopaedics wards in the Kuala Lumpur General Hospital (HKL) Inclusion and exclusion criteria : Yes
Were appropriate controls selected?	No information	Yes. Control groups: conventional debridement
Were data collection methods the same for the cases and controls?	No control group. Data collection method is quite clear and detailed	Yes

Evidence Type: Cohort study

TABLE 4

Questions	Sherman, R.A
Was there a representative and well-defined sample of patients at similar point in the course of the disease?	Yes. Detailed description of the population the exposure and nonexposure
Was follow-up sufficiently long and complete?	Yes. The study between 1990-1995. For each intervention wounds was monitored at least 2 week
Were objective and unbiased outcome criteria used?	Yes. The study used objective outcome measurement and explained very clear (see: evaluation table)
Did the analysis adjust for important prognostic risk factors and confounding variables?	Not really clear, but it said that when the patients in conventional therapy and the wound did not improve, the maggot therapy was initiated

Evidence Type: systematic review

TABLE 5

Questions	Smith F, et al.
Are the studies contained in the review RCTs?	Yes
Does the review include a detailed description of the search strategy to find all relevant studies?	Yes
Does the review describe how validity of the individual studies was assessed (e.g.,methodological quality, including the use of random assignment to study groups and complete follow-up of the subjects)?	Yes
Were the results consistent across studies?	Not clear because there is different interventions
Were individual patient data or aggregate data used in the analysis?	Yes

Step 2: What are the results?

Evidence Type: Case/ Case control study

TABLE 6

Questions	Geliad, L.,et.al	Paul, A.G.,et al.
Is an estimate of effect given (do the number add up)?	Yes	Yes
Are there multiple comparison data?	Yes	Yes
Is there any possibility of bias or confounding?	No	No

Evidence Type: Cohort study

TABLE 7

Questions	Sherman, R.A
What is the magnitude of the relationship between predictors and targeted outcomes?	There is significance differences favorable in MDT, with CI 95% n p<0.05
How likely is the outcome event(s) in a specified period of time?	Explained of outcomes is very detailed and used the appropriate data analysis
How precise are the study estimates?	Very detailed

Evidence Type: systematic review

TABLE 8

Questions	Smith F, et al.
How large is the intervention or treatment effect?	Unclear because there is no data analysis for gathered studies and variances of study purpose
How precise is the intervention or treatment (CI)?	

Step 3: How can I apply the results to patient care?

Although there are variance results of the study (in different articles), most all the study are applicable to implement in Indonesia because population of the studies are similar to our patients and almost all studies are worthy to be evidence base of our clinical practice. Beside that maggots debridement therapy now can easily find, although the price is more expensive compared with materials used in conventional debridement, but because the results of MDT need less time to wound healing so it have more cost-effectiveness.