

An Exploration of Public Perceptions and Attitudes Towards Maggot Therapy

Short title: Public perceptions of Maggot Therapy

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Conflict of interest Statement

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Ethical approval

Ethical approval for the focus groups and online survey was obtained through CHHS SU Research Ethics Committee.

Abstract

Aims

The aim of the study was to explore public opinion and perception of maggot therapy (larval therapy), a treatment option for chronic wounds.

Methods

The study utilised a mixed-method approach to obtain quantitative and qualitative data. A focus group was held to explore opinions and views of maggot therapy with a small group of individual members of the public. Analysis of emerging themes from the focus group was used to design an anonymised web-based survey, which was made available online to members of the public through email and social media.

Results

The focus group participants identified four key themes concerning the acceptability of maggot therapy. Four hundred and twelve participants completed our subsequent online survey, analysis of which revealed some worries and fears. Only 36% of survey participants agreed that they would accept maggot therapy as a first choice for a hypothetical painful wound, although this number increased with wound severity. The most predominant concerns of maggot therapy were sensation and a feeling of disgust associated with the therapy. However, participants could see some benefits to maggot therapy.

Conclusion

Our study showed that public perception of maggot therapy is varied. Survey participants expressed worries and fears associated with its use. However, positive relationships existed between knowledge scores and potential acceptability of maggot therapy, suggesting that information dissemination and education may be an important factor in perception and acceptability of MT.

Key words

Chronic wounds, maggots, maggot therapy, larval therapy, public perception.

Key points

- 1 The majority of participants in an online public survey would be unsure or reluctant to agree to maggot therapy as a first choice for a painful wound**
- 2 Barriers towards maggot therapy included participant's worries about the sensation that may be felt and the thought of maggots, which "made their skin crawl"**
- 3 Perceived benefits of maggot therapy included efficacy of the treatment and the short time span of the treatment**
- 4 Knowledge about Maggot Therapy was shown to be an important factor in its acceptability**

Reflective questions

- 1. Would it be desirable to help the public (patients) to acquire a greater knowledge of Maggot Therapy?**
- 2. How could better dissemination about the life cycle and action of medicinal maggots be achieved?**
- 3. Should we pay more attention to the opinions and views of Healthcare practitioners given that they appear to have a large influence on patient acceptability of maggot therapy?**

Introduction

Chronic wounds are slow or non-healing wounds like leg ulcers, which often result from co-morbidities such as diabetes and cardiovascular disorders, imposing a significant burden to the individual, families and healthcare systems.¹ For example, in Wales (UK), the prevalence of chronic wounds is currently estimated at 6% of the population with a concurrent cost of 5.5% of the National Health Service (NHS) budget (£303million).² Complications of chronic wounds can be extremely severe and include infections such as cellulitis, gangrene, haemorrhage and lower-extremity amputations.³ Wounds are managed by a range of healthcare practitioners, and in the UK, chronic wound care is predominantly nurse-led. To allow chronic wounds to progress and heal, it is accepted that unhealthy, dead and infected tissue must first be removed.⁴ A multitude of dressings and treatments exist to help manage the debridement of chronic wounds and include surgical, enzymatic, autolytic and biological debridement.⁵

One such treatment for debriding chronic wounds is maggot therapy (MT) or larval therapy which involves the application of living, aseptically reared, clinical grade medicinal maggots onto a necrotic, sloughy or infected wound. Although evidence exists of ancient tribes and traditional cultures using maggots to help heal wounds, the modern use of MT began in the 1930s, with over 300 hospitals in US and Canada using it to help treat chronic and infected wounds.⁶ At that time, MT never quite reached Britain and Europe, and there were strong debates about its acceptability in the UK.⁷ In the British Journal *Medical Annual*,⁸ it was argued that the treatment would never be used in Britain because ‘the word maggot was

repulsive, and neither the profession nor the public would favour the method.” In the 1940s, however, antibiotics became industrially mass produced and readily available and the use of MT disappeared altogether. Today, we find ourselves on the verge of catastrophic global antibiotic resistance,⁹ with a worldwide rise in patients with antibiotic-resistant wound infections.¹⁰ This, coupled with the increased burden of chronic wounds in the UK and worldwide has led to a progressive re-emergence of MT as a viable wound treatment.¹¹ Maggots are now available on UK NHS prescription and Food and Drug Administration (FDA) approved for use in US and several other countries.

An abundance of published literature, including clinical trials, supports the view that medicinal maggots work very quickly and selectively to clear away dead tissue.¹²⁻¹⁴ Studies also show that maggots exhibit unique and effective antimicrobial and wound healing properties.¹⁵ However, given its debriding efficiency and its cost effectiveness,¹⁶ and facts such as a chronic wound typically takes £2333 and 89 days to debride, while a wound debrided by MT costs £209 and initial treatment takes 5 days,¹⁷ maggot therapy has a surprisingly low uptake and is increasingly regarded as an extremely effective yet underutilised clinical treatment for chronic wounds.¹⁴ The reasons for this underutilisation may be multifactorial, but effective administration of MT depends on agreement between clinician and patient. Many reports and authors refer to the intrinsic presence of a preconceived cultural dislike of maggots, historically reported as the “Yuk Factor”.¹⁸⁻¹⁹ Here, we report results of our investigation into public opinion and perceptions of MT, with an aim to identify emerging key themes which may be associated with the idea of MT, and perhaps therefore its potential use and uptake as a wound treatment.

Methodology

Research Design

The research study utilised a mixed-method approach to obtain quantitative and qualitative data on public perception and opinion of MT. The design consisted of two stages:

Stage One

Stage one was implemented through a focus group conducted with ten members of the public. The discussion was guided by four key questions: a) participant's awareness of maggot therapy, b) participant's reactions to the concept of maggot therapy c) participant's knowledge of maggot therapy and d) participants' own willingness to accept maggot therapy if ever needed. The focus group lasted around an hour and field notes were taken (by author SW). A graphic record of the focus group findings was also captured.

Qualitative data obtained from the focus group was used to identify emerging key areas and themes which were noted for further exploration in Stage two.

Stage Two

Stage two was implemented as an online survey designed from themes uncovered in Stage one. The survey consisted of twenty-two questions. The design of the survey included two types of responses: Dichotomous questions asked about participant knowledge (Yes/No responses only); Responses to questions which were seeking participant opinion and perception were offered on a 5-point Likert scale (Strongly agree, agree, neither agree nor disagree, disagree and strongly disagree).

Additionally, data was collected to measure gender, age, geographical location, academic qualification, profession, and prior personal experience of MT.

Participant recruitment

Participation was open to any adult who met the inclusion criteria. Inclusion criteria included aged 18+ years, ability to complete the study in the English language, and ability to give consent. Exclusion criteria was solely any prior personal experience of MT (to eliminate the introduction of any bias).

Stage One

Email invitations for participants to attend the public discussion were sent to community groups and employees of local businesses, with an additional open invitation to invite their families and friends. The general theme for the focus group was stated as Maggot Therapy. No other details were given but exclusion criteria detail was provided. Responding participants who met the inclusion criteria were invited to attend the focus group at the set date and time. A free lunch was provided.

Stage Two

The on-line survey was advertised publically using study adverts in the local community, University all-staff emails, and a network of international social media (Twitter and Facebook). An information sheet on maggot therapy was displayed

electronically for online participants before they undertook the survey (Appendix Table (i)).

The research was conducted between December 2015 and January 2017.

Data collection and analysis

Stage One

A qualitative descriptive approach was used to identify the main themes that emerged from the focus group, using field notes and an artist illustration technique.²⁰ Participant responses were coded and key themes and sub themes identified. A random sample of scripts were selected for confirmation of themes by two independent coders. Agreement was found in over 90% of cases. The themes that emerged were used to develop the survey in stage two.

Stage Two

Responses from the survey were analysed using SPSS version 22. Statistical T-tests were used to compare responses for participant gender, whilst Pearson's r correlations were used to explore the association between responses and participant demographics.

Knowledge and barrier scores

A knowledge score was calculated by adding up the total number of statements presented that were already known by participants. The knowledge score ranged from 0–8 statements known, with a mean of 4.36 (SD: 2.28). A barrier score was also calculated on responses to statements about barriers to MT. The overall

perceived barriers score was computed by adding response to each barriers item. A lower score indicated greater perceived barriers as 1 = strongly agree and 5 = strongly disagree.

Regression analyses

A series of linear regression analyses, placing choice to use maggot therapy in different scenarios as the outcome variable and barriers, benefits and knowledge as the predictor variables

Finally, a content analysis approach was used to categorise the open box responses, which some participants provided.

Ethical considerations

Ethical approval was obtained through College of Human and Health Sciences, Swansea University Research Ethics Committee for the survey and the focus group. All aspects of the Declaration of Helsinki 1964 were adhered to.

Results

Stage One

A total of ten members of the public (who met the inclusion criteria) attended and took part in the MT focus group discussion. There were six female participants and 4 male participants, aged between 30 – 70 years. At the start of the focus group, emotions and attitudes were mixed when asked for thoughts on MT. Only 20% of the group were wholly positive and accepting about the idea of maggot therapy, 10% were unsure, but the majority (70%) were very reluctant. The latter group of participants, in particular, expressed concerns and fears surrounding the use of MT. However, a perceived benefit was the natural quality of the therapy, and several participants stated that they would be guided by the opinion of their health practitioner.

Overall, participants of the focus group identified and described several ideas, concerns, perceived barriers and benefits, which were noted and captured by a real-time graphic recording artist. A visual representation of the discussion was produced as a drawing that brought together some study information to facilitate discussion, and generated participant thoughts and opinions (**Figure one**).

From field notes, four main themes emerged from the discussion:

1. Acceptance of the therapy would depend on severity of wound and level of desperation for the wound to heal.
2. Key barriers were identified, such as fear of sensation and general dislike/fear of insects and “creepy crawlies.” In addition, a negative association of maggots with

death and decay was evident, and participants identified a fear of maggots escaping or turning into flies during treatment.

3. Lack of awareness of MT benefits
4. Lack of knowledge about MT

As the discussion concluded, all participants felt that more education and information was needed to ensure a better understanding of how MT works, and that if patients and the public were made more aware of the benefits of this type of therapy, this may help address fears and anxieties that they associated with maggots and MT.

Stage Two

The findings and core themes which emerged from stage one determined the development of questions and scenarios that formed the public online survey. These were grouped into four categories based on key themes identified from stage one above: 1) Participants willingness to try MT, 2) participant perception of barriers to MT, 3) participant perception of benefits of MT and 4) participant knowledge of MT. Four hundred and thirteen people (adults) completed the survey and four hundred and twelve of these successfully met the inclusion criteria. (One respondent had previously received maggot therapy treatment for an infection following a leg amputation, and thus was excluded from the survey sample). Thirty-eight participants knew someone who was offered therapy and accepted it, with seven knowing someone who had declined it. One participant suggested to their health professional that they had maggot therapy and the professional accepted (participant above), whereas three participants suggested it and had their request declined.

Out of the 412 participants, one hundred and thirty-nine (33.7%) were male and two hundred and seventy-three (66.4%) female. Participants ranged across all age brackets (although 92.7% were aged 18 – 59). Responses were obtained from participants across UK, USA, Canada, South Africa, Australia and New Zealand. Three hundred and seventy participants (89.8%) had heard of maggots being used to treat wounds. Eighty six percent of participants had a degree or above. Most participants were University employees.

1) Participant willingness to agree to MT

Participants were asked to imagine a series of scenarios (**Table 1**) in which they might receive MT and to consider how strongly they would agree to have the treatment. Results are shown as the percentage of participants who either strongly agreed/agreed, strongly disagreed/disagreed or were unsure. Scenario one was the use of MT as a first treatment for a painful wound. Given this scenario, 36.2% participants strongly agreed/agreed they would be willing to have the therapy and 63.8% did not agree or were unsure (31% strongly disagreed/disagreed and 32.8% were unsure). The percentage of participants who strongly agreed/agreed was deemed low considering how many participants had heard of MT (36.2% and 89.7% respectively). For scenario two, a painful wound that hadn't healed in one month, a greater number of participants (80.4%) strongly agreed/agreed they would be willing to accept MT. For both scenario three (a painful wound that hadn't healed in 6 months) and scenario four (which involved a limb amputation), 92.97% and 91.6% participants respectively strongly agreed/agreed they would be willing to accept MT (**Table 1**). The data revealed a steady increase in the number of participants who

felt they would be more willing to try MT as the hypothetical severity of their wound increased.

2) Participant perception of barriers towards Maggot Therapy

Participants were asked how strongly they agreed or disagreed with a series of statements regarding barriers towards MT. The percentage of participants who strongly agreed/agreed and strongly disagreed/disagreed is shown in **Table 2**.

Interestingly, no statement was shown to be an overwhelming barrier for the majority of participants, with “worry about the sensation of MT” having the highest percentage strongly agreeing/agreeing (52.8%). Almost 41% of participants strongly agreed/agreed that the thought of MT made their skin crawl and 35.5% of participants strongly agreed/agreed that maggots were disgusting. Only 3.3% strongly agreed/agreed that the idea of MT was stupid, and only 2.5% felt that it would not work. With regards to pain and limb amputation, very few participants strongly agreed/agreed that they would prefer this to MT (1% and 0.8% respectively), (**Table 2**).

Significant differences appeared in perceived barriers by gender. Women (N=273) were more likely to perceive disgust and have negative feelings towards MT than men. Women were more likely: a) to worry about the sensation ($t(387) = 3.260$; $p=0.001$); b) to perceive maggots as disgusting ($t(387) = 4.345$; $p<0.001$); c) to associate maggots with death ($t(387) = 2.390$; $p=0.017$); d) for the thought to make their skin crawl ($t(387) = 6.421$; $p<0.001$), e) for the thought to make them feel ill ($t(387) = 4.796$; $p<0.001$).

The association between perceived barriers and readiness to accept maggot therapy was examined using Pearson's correlations. All barriers significantly predicted each choice. The greater the perceived barrier, the less likely an individual would be to consider MT as a treatment (**Table 3**). As so many barriers predicted choice, a series of regression analyses were performed to explore which attitudes predicted the choice made. The following barriers remained significant: **For MT as a first choice of treatment:** I would prefer to take medication ($p < 0.001$), I prefer conventional treatment ($p < 0.001$), I don't think they would work ($p = 0.022$). **For MT after having a painful wound for one month:** I prefer conventional dressings ($p < 0.001$). The thought of MT makes me feel ill ($p = 0.002$). **For MT after having a painful wound for six months:** The thought of MT makes me feel ill ($p < 0.001$), I think the idea is stupid ($p = 0.008$), I prefer conventional dressings ($p = 0.009$), I associate maggots with death ($p = 0.021$), They are disgusting ($p = 0.025$), I worry it would hurt ($p = 0.038$). **For MT if needed a limb amputated:** I would prefer to have a limb amputated ($p < 0.001$), I prefer conventional dressings ($p = 0.012$), I think the idea is stupid ($p = 0.040$) (**Table 3**).

3) Participant awareness of benefits of MT

Participants were invited to reflect on a series of statements examining the perceived benefits of MT. The percentage of participants who strongly agreed/agreed and strongly disagreed/disagreed with each benefit is shown in **Table 4**. Results are shown as the percentage of participants who either strongly agreed/agreed, strongly disagreed/disagreed or were unsure. The greatest benefits were perceived to be 1)

MT was better than wound pain (91.2% participants strongly agreed/agreed), 2) the efficacy of MT (90% participants strongly agreed/agreed), and 3) the short time period of treatment (69.8% participants strongly agreed/agreed). A high percentage of participants (71%) strongly agreed/agreed that they had a trust in treatments offered by the medical profession (**Table 4**).

Significant differences appeared in perceived benefits by gender. Women (N=273) were significantly more likely than men to perceive the following benefits: a) like alternative (non-conventional) treatments [t (386) = 5.556, p<0.001], b) It is a short treatment [t (386) = 2.785, p<0.001], c) believe nature has the answer [t (386) = 3.998, p<0.001]

4) Participant knowledge of how MT works

Participants were given a series of facts about the MT process and asked whether they were aware or had heard of any of these facts. The number of participants who had heard of each fact is shown in **Table 5**. The fact that appeared to be the most well-known was that maggots used in MT could not eat healthy tissue (86.4% participants knew this) and the least known fact was that it was only baby maggots which were used for MT (17.6% participants knew this). Less than one third (30.2%) of participants knew about the short duration (3-7) days of MT treatment.

Knowledge scores and relationship of knowledge to acceptance of MT

A knowledge score was calculated by adding up the total number of statements presented that were already known by participants (**Table 5**). The knowledge score ranged from 0–8 statements known. The mean knowledge score of participants was 4.36 (SD \pm 2.28). No significant difference in knowledge score was found for gender, and no significant association was found between age and knowledge. The greater an individual's knowledge score however, the more likely they would be to strongly agree/agree to the use of maggot therapy as a first treatment for a painful wound (Pearson's $r = -.263$, $p < 0.001$). Additionally, an overall perceived barriers score was computed by adding response to each barriers item from Table 2. A lower score indicated greater perceived barriers (as 1 = strongly agree and 5 = strongly disagree). Analysis of the relationship between knowledge and perceived barriers indicated that the greater an individual's knowledge Score, the lower their perceived barriers (Pearson's $r = .489$, $p < 0.001$).

Open-ended survey responses

Participants were invited to make any further comments in an open box at the end of the survey. A total of seventy-five participants provided comments and out of these, twenty-six were considered general comments on the survey, research, expressions of interest in the topic etc. and were not analysed further. Of the remaining forty-nine comments, twenty-one were positive towards MT such as *"An excellent form of treatment!"*, and *"You would be mad not to take the chance of this therapy"* (**Table 6a**). Interestingly, three participants saw the positivity only if a doctor or health care practitioner recommended the therapy, for example, *"I would have no problems trying the treatment should it be recommended by a Health Professional"*. Other

comments indicated that a better knowledge of maggot therapy may help with participant acceptability of MT, for example, *“Knowing (now) that they are babies and enclosed in a bag is the most reassuring aspect for me!”* and *“I learned new information about the treatment, and found my attitudes were changing by the end of the survey. Taking the survey has meant I would be more inclined to consider this treatment if I ever needed it”* (**Table 6a**).

However, twenty-eight comments made by participants were considered negative. These specifically reflected participants worries, fears and concerns and were grouped into themes **Table 6b (a-h)**. Samples of comments under each theme are presented. Interestingly, some of the major theme groups identified were similar to those that had emerged previously in the focus group of Stage one (**Figure 1**). The greatest number of negative comments (9/28) fell under the theme of preconceived/cultural conceptions, for example *‘I just think it’s ingrained to associate maggots with death and difficult to change that feeling’* (**Table 6a**). This was followed by negative feelings associated with the disgust “skin-crawling” element (5/28), such as *“They make me shudder at the very thought – that skin crawling sensation”,* and *“I know I should really like the idea but my skin is crawling!”* (**Table 6b**). Some participants (5/28) mentioned that the term maggot itself was a negative concept and these participants suggested removing the word “maggot” from maggot therapy (**Table 6c**). Comments were also made to indicate that the visibility of maggots applied was important (3/28), for example, *“I don’t want to see them..”* and *“My “disgust factor” would be lower the smaller the maggots are”* (**Table 6d**). A few comments reflected participants phobia of insects (3/28) (**Table 6e**). and fears of the maggots themselves (2/28) – *“I’m worried they could somehow get inside me!”*

(Table 6f). One comment reflected a concern about what others may think of participants if they agreed to MT - *'I think I'd worry about being stigmatised by others during the treatment'* **(Table 6g)**, and one participant noted that the fact that MT, as with other alternate treatments, was not considered to be the best treatment e.g. *"I also don't like that it is seen as an alternative treatment. Alternative in my mind is breaking or going against convention and perhaps a less powerful treatment"* **(Table 6h).**

Discussion

Following an exploration of ideas from a small public focus group, we developed a public online survey on perceptions of Maggot Therapy (MT). Our study examined the views and opinions of four hundred and twelve members of the public to better understand the thoughts and perceptions regarding the use of MT to treat chronic wounds. Interestingly, whilst almost 90% of participants in our study had heard of maggot therapy, just over one third of these only said they would initially accept MT if it was offered if as a first treatment for a painful wound. So, even though awareness of MT was very high amongst our participants, this was not reflected with a corresponding high acceptability of maggot therapy. Although the majority of participants agreed that treatment of chronic wounds with maggots could work, and that the idea of MT was not stupid, when presented with hypothetical clinical scenarios, only 36% of people surveyed said they would agree to MT as a first treatment for a painful wound. However, there was a proportion of participants (one third) who did not reject the idea outright, but said they were unsure. This demonstrates the huge potential to sensitise and inform these participants further so armed with more knowledge and evidence perhaps they could be persuaded (either way). Indeed, participants became increasingly more likely to agree to accept MT if their hypothetical wound had been chronic for some time, or if their only other option was amputation, suggesting that MT became more acceptable when the severity of the wound increased and perhaps the level of desperation became more pronounced. This reflects the current clinical situation where MT is almost always considered as a last resort for the treatment of chronic wounds.²¹

Perceived barriers towards Maggot Therapy

Participants identified with some of the potential concerns and anxieties that could be associated with the therapy. Over half of our study participants felt worried about the sensation of maggots during MT. Whilst worrying about the sensation of MT appeared to be a significant barrier for our study participants, studies report that patients describe the sensation of maggots on their wounds as “tickly” and state that often the thought (of MT) is much worse than the actual sensation experienced.²² However, for between 5%-30% of patients (often those with ischaemic tissue), there may be some pain associated with MT,¹⁴ although this is usually lessened with the administration of mild pain relief.²³⁻²⁴

The perception of disgust

Forty percent of participants in our survey said that the thought of MT “made their skin crawl” and more than one third of participants felt that maggots were disgusting. Disgust is a universal physiological reaction of all human beings. Curtis et al.,²⁵ suggested that the sensation of disgust has evolved primarily for protection. Several things such as bodily secretions, wounds, corpses, decaying meat or rubbish, and certain living creatures like flies, maggots and rats are considered revolting. Remarkably, a recent study of over 500 patients with chronic ulcers, found that 60% of patients considered images of maggots to be more repulsive than images of gangrenous wounds.²⁶ In addition, a number of our survey participants mentioned the negative sensation associated with MT they described as “making their skin crawl” which was also noted above as a worry in the perceived barriers of our

survey. Often associated with repulsion, fear or disgust, this is a common response to maggots, and in fact, in a study by Spilsbury,²⁷ it was reported that a major reason amongst patients who refused MT was “the thought of maggots” and it made them “feel sick”. Reports suggest that disgust is a multifaceted emotion, a product of culture, socialisation and early learning,²⁸ and it is widely accepted that its evolutionary origin was to prevent the ingestion of harmful substances.²⁹ Researchers believe that disgust is associated with a heightened risk perception,³⁰ and if that is so perhaps perceptions of maggots as “disgusting” could conceivably be “unlearnt” by people to whom the risk association with MT was disaffirmed and more positive information provided about the medicinal and health benefits maggots provide. If so, there would need to be a major concerted public health drive to change this inherent negative perception of maggots. Additionally, feeling disgust/dislike towards a particular object or organism though is not always innate. For example, somewhere within childhood, people may begin to learn that maggots are creatures related to acts of decomposition and decay, and as a result, a negative perception is developed which appears to persist into adulthood. In order to tackle the development of learned and associated disgust, one way could be perhaps to introduce maggots as beneficial insects to younger school children.³¹

The question over patient apprehension or uneasiness regarding treatment of chronic wounds with maggots is an on-going one. However, whilst we report a level of discomfort expressed by public participants in our survey, studies postulate that this factor may not really exist in patients. Due to wound chronicity, individuals with severe, non-healing wounds rarely refuse MT.^{19,32} A small, qualitative study (VenuS

II trial) undertaken involving eighteen patients with chronic wounds found that all patients reported disruption to their lives because of the wound. Distresses such as wound pain, restricted mobility, disturbed sleep were described and, as such, the majority of participants (fifteen) were willing to try MT.²²

Other open-ended comments in our survey which were perceived as barriers included the “sight” of maggots, and the dislike of the term “maggot.” For some individuals the very word “maggot” can invoke immediate negative connotations, such as images of rot and decay,¹⁸ and it is perhaps for this reason that the major European company that produces clinical grade larvae for medical distribution (BioMonde), refers to maggots as “Larvae.” In addition, for clinical use, maggots are enclosed in a small, sealed bag and covered with a dressing, so patients would not normally see them except perhaps on removal if they wished.

Unsurprisingly, participants who strongly agreed/agreed with perceived barriers showed less readiness to accept MT. For these participants, the preference of conventional dressings, and preference to take medication, were significant factors linked to less likelihood of considering MT.

Gender differences in perception of barriers to Maggot Therapy

Interestingly, gender differences were found between participants responses to perceptions of MT barriers. Women were more likely to find maggots disgusting; they

were more likely to be worried about the sensation of MT; and they were more likely to feel ill at the thought of MT. These results indicated a higher level of discomfort and unease about MT for women. This finding reflects other studies exploring gender differences in patient perception of maggot therapy. For example, a survey of preferences and acceptability of maggot therapy revealed that the majority (7 out of 8 patients who refused maggot treatment were women (7/8)).²⁷ It has been hypothesized from an evolutionary perspective and in relation to offspring survival, women reportedly have much higher levels of disgust for many different things, including pathogens, sexual and moral disgust.³³

Perceived benefits of Maggot Therapy

Study participants were able to perceive several benefits of MT. The most agreed benefit was relief from wound pain, but also the efficacy and short duration of the treatment. Over 70% of participants felt that they trusted treatment if offered by a medical professional, emphasising the influence that health practitioners may have over patients' (and public) acceptance of the therapy. With MT, clinicians may have to deal with multiple disgust responses (stagnant wounds and bodily secretions as well as any negative emotions that maggots might invoke). This may affect their own willingness to offer or participate in this therapy. Whilst there has been some research conducted on how patients deal with chronic wounds, there has been very little research on how nurses manage their own feelings of disgust.³⁴ One survey conducted, however, showed that health-care professionals and administrators are much more likely to be repulsed by the thought of maggot dressings than the actual patient suffering with the chronic wound.³⁵ Some studies also suggest that more

thought needs to be given to psychological/psychosocial issues for health professionals involved with patient and wound care,³⁶⁻³⁷ and some authors consider if clinicians themselves have negative feelings or an inherent dislike of maggots, perhaps they may be less keen to prescribe or use them.³⁸ We are currently investigating this in a separate study.

Gender differences in perception of benefits of Maggot Therapy

Our study showed that women were significantly more likely to perceive certain benefits of MT than men were. Such perceived benefits included the belief that nature has the answer, and the liking of alternative treatments. The latter finding is in line with several studies on gender and the use of alternative treatments. In a study examining the use of complementary and alternative medicine (CAM) for patients with migraines/severe headaches, women were found to consistently use CAM more frequently than men,³⁹ and similarly, a large study examining adults with multiple chronic conditions revealed that significantly more women had previously used CAM, but were also more likely to use it to try and help their condition.⁴⁰ Explanation for this gender difference in acceptance of alternate therapies include a belief that women have a greater propensity to seek care,⁴¹ and are considered more proactive towards health issues.⁴² Indeed 66.4% of our study participants were women, perhaps indicating a prior interest in the topic or a greater willingness to complete the survey. The skewed interest has been reported before for surveys on alternative therapies, for example, significantly lower numbers of men (93/408) were found to participate in online surveys about herbal medicine and medicinal plants.⁴³

Participant's Knowledge of Maggot Therapy

Participants in our study had a good awareness of MT and appeared to have heard of many of the facts we presented regarding MT. Importantly, calculation and analysis of knowledge scores revealed that participants with a higher knowledge score were more likely to accept MT in the hypothetical wound scenarios. Moreover, participants with higher knowledge scores, also perceived fewer barriers towards MT. The existence of these positive relationships between knowledge scores and acceptability of MT treatment provides encouraging evidence to suggest that information dissemination and education regarding maggots and MT may be an important and influential factor for the perception of MT. This was indeed mentioned by the focus group participants (in Stage 1) who agreed that more general information about MT was needed and should be made readily available to the public. Also, some participants had fears or worries based on inaccurate knowledge and beliefs, for example, the fear that the maggots used could invade their bodies. The concern that maggots could somehow burrow or embed into the skin and body tissue was also raised by two participants in free comments at the end of the survey. The maggot species used in MT is non-invasive and cannot do this, so this sort of worry or fear is easily abatable, but the comments do highlight need to offer better information to improve public understanding. A common strategy to challenge mistaken beliefs and remove the influence of erroneous information is by providing, educating and adding correct information.⁴⁴ This could perhaps be an important public health consideration, if indeed increasing acceptability and uptake of MT is to be a desirable outcome.

Other free comments on Maggot Therapy

Participants did make several positive free comments about MT, including the fact that recommendation by a healthcare practitioner was a reason to agree to the therapy. This is clearly an important point which has already been discussed above. A few positive comments reflected the fact that knowledge and learning new information about maggots made participants more likely to consider the treatment if needed, emphasising again the importance of enhancing awareness and understanding of MT through public education opportunities.

However, twenty eight of the forty-nine comments made by survey participants were associated with negative perceptions, fears and worries. Some participants felt that they could not overcome prior negative associations with death. Participants often associated maggots with harm e.g. death or as bait for fishing or a “cultural aversion.” They found it hard to disassociate from this. Conversely, a study on perception and acceptance of MT in leg ulcer patients found that all patients who went fishing had no fear of maggots and all would consider MT.²⁷

A few participants raised the idea that they were phobic to insects. This made them very anxious about the concept of maggots crawling on them. People with a phobia of insects (Entomophobia) may have a real anxiety and insurmountable fear, perhaps based on prior experience or trauma or may consider insects as dirty, disease-spreading creatures.⁴⁵ Invertebrates, in general, are held in low regard with the public.⁴⁶⁻⁴⁸ Relevant to the present study, Davey⁴⁹ ranked maggots as 6th out of

35 in terms of animals that caused anxiety in a cohort of university students. Phobic individuals with high anxiety to MT may not be able to de-condition enough to accept it, although recent studies have considered the use of gaming elements and the development of new gaming approaches to try and reduce various types of phobia.⁵⁰ Perhaps the development of an online Maggot Therapy video/computer game may be useful tool to accompany any public information dissemination on MT.

A concern was also noted regarding perceived stigma of MT. One participant described how they would worry that if they were having treatment, others would have a negative reaction and avoid them. A survey amongst 38 chronic wound patients in a study in the Netherlands, found that a high number of patients reported adverse social interactions as a result of undertaking MT.¹⁹ The authors suggested that public acceptance is important to reduce worry, and keep adverse feelings of patients to a minimum, and felt that there was a need to decrease the general prejudice towards maggot therapy so people may reconsider their ideas about maggots. However, it must be noted that patients living with a chronic wound may already experience negative effects of self-image which could impact on social interactions.⁵¹ Another study reported that patients who refused MT under any circumstance, reported a “squeamishness”, and an aversion to MT and a negativity that was shared by their family members.²² In addition, researchers have observed that whilst a negative perception may not necessarily be paramount in patients suffering non-healing, long standing chronic wounds, it was nonetheless evident in family members and other people in their social spheres.⁵²

Finally, for one participant, the perception of maggot therapy as an “alternative” treatment discouraged them. Although, as discussed earlier, gender analysis did reveal that significantly more women participants liked alternative therapies, the preference for conventional treatments and taking medication over MT was reflected in our findings above on barrier perception, suggesting a wariness of MT as an alternative therapy. Other recent surveys report that whilst the use of complimentary alternative medicine has gained in popularity, it is still very dependent on sociodemographic factors such as education and gender but also belief and attitude.⁵³ Even though MT is an approved clinical treatment, with FDA and UK NHS approval, it is still considered an alternate therapy. It may therefore be a good time to review this label and align MT with other mainstream wound treatments.

Conclusion

Our study has shown that the public perception of maggot therapy is varied. The majority of participants in our survey would not agree to, or were unsure about, choosing MT for an initial painful wound. However, if faced with a severe, prolonged chronic wound or limb amputation, the majority of participants felt that they would agree to MT. Clearly, there is scope to inform and convince members of the public who waver in their acceptance of MT. However, we did identify concerns over the potential sensation experienced and an element of unease about the use of maggots. We also showed how important knowledge and a better understanding about MT could be on acceptability. Chronic wounds are unlikely to decrease in number or severity in the future. Accumulated evidence suggests that maggot therapy sits high amongst wound management treatments with regards to its speed

and efficacy. It would be important to ensure that the potential advantages that maggots can offer are not lost due to public reluctance, lack of understanding or perceived fears. A key component in combatting negative perceptions of maggot therapy may lie in a public engagement campaign or improved public and patient engagement with health practitioners (and others), in order to temper fears and anxieties, provide reassurance and advance communication of its significant clinical benefits.

Table 1. Willingness of questionnaire participants to try maggot therapy in different scenarios (N=412). Results are shown as the percentage of participants who either strongly agreed/agreed, strongly disagreed/disagreed or who were unsure.

	Percentage participants who Strongly agree or agree N=412	Percentage participants who Strongly disagree or disagree N=412	Percentage participants who were unsure (neither agree nor disagree) N=412
I would try maggot treatment as a first treatment for a painful wound	36.2%	31.0%	32.8%
If I had a painful wound that hadn't healed in one month, I would try maggot treatment	80.4%	6.6%	13%
If I had a painful wound that hadn't healed in six months , I would try maggot therapy	92.9%	2.2%	4.9%
If I was told I needed to have a limb amputated I would try maggot therapy	91.6%	1.7%	6.7%

Table 2. Percentage of participants perceiving barriers to maggots and maggot therapy (N=412). Results are shown as the percentage of participants who either strongly agreed/agreed, strongly disagreed/disagreed or were unsure and neither agreed nor disagreed

Barrier	Percentage participants who Strongly agree or agree N=412	Percentage participants who Strongly disagree or disagree N=412	Percentage participants who were unsure (neither agree nor disagree) N=412
I would prefer other conventional dressings	39.8%	17.9%	42.3%
I don't think they would work	2.5%	86.3%	11.2%
I think the idea is stupid	3.3%	92.5%	4.2%
I worry about the sensation	52.8%	32.3%	14.9%
I worry it would hurt	24.1%	59.9%	16%
They are disgusting	35.5%	42.3%	22.2%
I worry they are unclean	15.0%	70.5%	14.5%
I worry they would turn into flies	20.1%	77.8%	2.1%
I associate maggots with death	25.1%	56.2%	18.7%
The thought makes me feel ill	27.6%	51.9%	20.5%
The thought makes my skin crawl	40.8%	43.5%	15.7%
I would prefer to have a limb amputated	1.0%	91.0%	8.0%
I would prefer to take medication	34.2%	33.2%	32.6%

Table 3. Associations between perceived barrier to MT and likelihood of

accepting MT in each scenario described in Table 1 (using Pearson's correlations). All barriers significantly predicted each choice. The greater the perceived barrier, the less likely a participant would consider having MT as a treatment.

Barrier	MT as a first choice with a painful chronic wound	MT after 1 month with a painful chronic wound	MT after 6 months a painful chronic wound	MT if a limb amputation was needed
I would prefer other conventional dressings	-.565, p<0.001	-.496, p<0.001	-.379, p<0.001	-.301, p<0.001
I don't think they would work	-.342, p<0.001	-.367, p<0.001	-.378, p<0.001	-.295, p<0.001
I think the idea is stupid	-.246, p<0.001	-.362, p<0.001	-.405 p<0.001	-.307, p<0.001
I worry about the sensation	-.349, p<0.001	-.325, p<0.001	-.261, p<0.001	-.174, p<0.001
I worry it would hurt	-.241, p<0.001	-.253, p<0.001	-.182, p<0.001	-.105, P=0.019
They are	-.407, p<0.001	-.409, p<0.001	-.414, p<0.001	-.278, p<0.001

disgusting		p<0.001		
I worry they are unclean	-.340, p<0.001	-.389 p<0.001	-.340, p<0.001	-.194, p<0.001
I worry they would turn into flies	-.310, p<0.001	-.316, p<0.001	-.300 p<0.001	-.149, p<0.001
I associate maggots with death	-.244, p<0.001	-.270, p<0.001	-.205, p<0.001	-.157, p<0.001
The thought makes me feel ill	-.478, p<0.001	-.468, p<0.001	-.458, p<0.001	-.297, p<0.001
The thought makes my skin crawl	-.460, p<0.001	-.378, p<0.001	-.351, p<0.001	-.222, p<0.001
I would prefer to have a limb amputated	-.132, p=.004	-.327, p<0.001	-.484, p<0.001	-.466, p<0.001
I would prefer to take medication	-.573, p<0.001	-.453, p<0.001	-.341, p<0.001	-.246, p<0.001

Table 4. Percentage of participants perceiving benefits to maggot therapy. (N=412). Results are shown as the percentage of participants who either

strongly agreed/agreed, strongly disagreed/disagreed or who neither agreed nor disagreed.

Benefit	Percentage participants who Strongly agree or agree N=412	Percentage participants who Strongly disagree or disagree N=412	Percentage participants who neither agree nor disagree N=412
I like alternative (non-conventional) treatments	31.1%	5.9%	6.3%
It is a short treatment	69.8%	5.9%	24.3%
It has been shown to work	90.0%	1.3%	8.7%
I trust treatments offered by the medical profession	71.0%	7.2%	21.8%
I believe nature has the answer	47.3%	14.2%	38.5%
It is better than wound pain	91.2%	2.0%	6.8%
I know someone who had a positive experience with maggot treatment	16.0%	38.5%	45.5%

Table 5 Percentage of participants with knowledge of each factor (N=412)

Fact	Percentage of participants who had heard
Maggots (used in MT) do not eat healthy tissue	86.4%
Maggots (used in MT) are clean and infection free	78.9%
Special maggots are grown for this purpose	65.9%
Maggots are kept in a small bag	44.7%
Maggots cannot escape (from bags)	49.5%
Treatment would take 3 – 7 days	30.2%
Only baby maggots are used	17.6%
The treatment does not hurt	64.9%

Table 6a. Sample of participants positive comments regarding Maggot Therapy

Positive comments regarding MT
<i>"I am extremely concerned about the increase of medication resistant strains of infections and think that maggot therapy can play an important role in the prevention of this happening."</i>
<i>The main problem is educating the GPs and nurses that the option of maggot treatment can be offered. I don't know anybody who has ever been offered maggot treatment and if the GPs and nurses would advocate it more strongly, patients would be more inclined to use it. Most patients will rely on what the doctor recommends.</i>
<i>"You would be mad not to take the chance of this therapy. It works."</i>
<i>"An excellent form of treatment!"</i>
<i>An excellent alternative to conventional medicine, possibly a cheaper option also</i>
<i>"I learned new information about the treatment, and found my attitudes were changing by the end of the survey. Taking the survey has meant I would be more inclined to consider this treatment if I ever needed it"</i>
<i>"Knowing (now) that they are babies and enclosed in a bag is the most reassuring aspect for me.</i>
<i>"I would have no problems trying the treatment should it be recommended by a Health Professional"</i>
<i>"If a doctor tells me I need a limb amputated, it's coming off. If they say that maggots is an alternative then of course I'd give them a go".</i>

Table 6b. Participants fears and concerns from open ended responses. Examples of responses are given under theme groups (a-h). The total number of participant fears

and concerns was 28 (N=28). Data in parenthesis indicates number of comments for each theme group.

a. Prior negative/cultural associations (9/28)
<i>"I associate maggots with fishing - as bait. seeing my grandfather/father/brothers hooking a live maggot is the memory that makes my skin crawl, and the smell as the tub was opened".</i>
<i>"I just think it's ingrained to associate maggots with death and difficult to change that feeling"</i>
<i>"I have a cultural aversion to maggots. But would be willing to try if the need ever arises...but I think there would have to be a real need".</i>
b. Sensation of skin crawling (5/28)
<i>"They really do make my skin crawl"</i>
<i>"They make me shudder at the very thought – that skin crawling sensation"</i>
<i>"I know I should really like the idea but my skin is crawling!"</i>
c. Dislike of term "Maggot" in Maggot therapy (5/28)
<i>"DO NOT use the word maggots. Maggots are familiar from everyday life, dustbins etc. as filth. Call them something slightly cute but explanatory: e.g. hygenies".</i>
<i>"Maggot therapy' is off-putting. Perhaps if it was referred to as something else e.g. biotherapy then it wouldn't have such a negative reaction".</i>
d. Dislike of the sight of maggots (3/28)
<i>"I don't want to see them.."</i>
<i>"My ""disgust factor"" would be lower the smaller the maggots are"</i>
e. Phobia of insects (2/28)
<i>"I love the idea but am somewhat phobic about insects/creepy crawlies and worry I would not cope well".</i>
<i>"I worry that I wouldn't be able to get past the idea of bugs running about all over me eating my flesh"</i>
<i>"I can fully see the benefits of maggot therapy however the thought is terrifying but no different I suppose to a phobia of spiders"</i>
f. Fears of embedding in the skin (2/28)

“My concern would be making sure the number of maggots introduced to the wound was the same number as were removed. The thought of one burrowing into the wound and staying there is very disconcerting.”

“I’m worried they could somehow get inside me!”

g. Worry about stigma (1/28)

“I think I’d worry about being stigmatised by others during the treatment.”

h. Dislike of alternate treatments (1/28)

“I also don’t like that it is seen as an alternative treatment. Alternative in my mind is breaking or going against convention and perhaps a less powerful treatment”

Appendix Table (i)

INFORMATION PROVIDED TO PARTICIPANTS BEFORE COMPLETION OF ONLINE SURVEY

Maggot Therapy

Everybody occasionally gets cuts or tears to the skin which naturally heal over time. Sometimes wounds can take a long time to heal and sometimes don't heal at all. This can leave the body open to infection as bacteria can enter the wound and can be painful, uncomfortable and interfere with day to day life.

Traditionally wounds may be healed with ointments, dressings or antibiotics but sometimes if the wound is very severe or long lasting this does not work. This can be very dangerous and lead in the worse-case scenario to a limb being amputated.

However more and more research is showing that maggots can be used to treat wounds. Maggots can clear infection, heal wounds and prevent limbs being amputated but many patients and health professionals are reluctant to use them.

The aim of this short questionnaire is to explore people's attitudes towards the use of maggots and any specific fears or concerns they would have against potentially receiving this treatment themselves. The findings will be used to inform and develop maggot research with the hope of balancing people's fear and disgust with how useful this treatment can be.

The study is a collaboration between Swansea University and Cardiff University. Participation is open to anyone aged over 18 years old. The questionnaire will ask you some general background questions about you and then explore your attitudes towards maggot therapy. It should take no longer than 10 minutes to complete.

Any information that you do give in the questionnaire will only be used for the purposes of the study and will be kept confidential. You will not be identified from your answers in any way. All the data obtained will be confidential to the study. If there are any questions you do not wish to answer for any reason, please leave them blank. In addition, if you do not wish to complete the questionnaire for any reason please do not continue.

If you wish to withdraw from the study you can do so simply by closing your browser. Please note that because the data will be made anonymous, it will not be possible to identify and remove your data at a later date, should you decide to withdraw from the study.

Importantly, if answering any of the questions raises concerns about your health in any way, you should contact your health visitor or GP for further advice or support. Maggot treatment may not be suitable for all so if you are having, considering or interested in maggot therapy please discuss this with your GP or health care provider.

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