Debridement of foot wounds in patients with diabetes mellitus

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Article points

1. Recognise the need for debridment in chronic wounds.
2. Choose an appropriate debridement technique.
3. Change debridement technique based on patient/wound needs.

Key words

- Chronic wound
- Debridement
- Diabetic foot
- Wound care

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Wound debridement is a process that assists its transition from a chronic, non-healing wound to one progressing towards a healed state. There are many debridement techniques that can effectively stimulate the wound towards this transition. Debridement can be effectively performed in the operating room, with expensive specialised equipment, or state-of-the-art wound clinics. This paper will focus on simple, effective forms of debridement that can be performed in most clinic settings: sharp excisional debridement, autolytic debridement, enzymatic debridement and biodebridement. Providing good wound care in clinics where people live can effectively prevent the need for many life altering major amputations.

Wound debridement is a process of removing fibrous, non-viable, necrotic, and infected tissue. This process has been a long-standing standard of care for wounds of any aetiology, including chronic neuropathic wounds of the foot (Steed et al, 1996; Attinger et al, 2000; Armstrong et al, 2002; 2004). The authors will focus on debridement modalities as it relates to diabetic foot wounds. Although this has been a well-established treatment modality for many years, there have not been many published papers discussing how appropriate debridement is performed (Armstrong et al, 2002; 2004).

It is well known that there are many factors that influence wound healing, with appropriate wound preparation or debridement, being only one of those factors. The purpose of this paper will be limited to the discussion of wound preparation. The clinician, however, should not omit the importance of appropriately treating any concomitant comorbidities that are known to affect wound healing: pressure, shear, infection, peripheral vascular disease, oedema and poorly controlled diabetes mellitus, for example (Bakker et al, 2016; Bus et al, 2016a; 2016b; Game et al, 2016; Hinchliffe et al, 2016; Lipsky et al, 2016).

Debridement of wounds, especially chronic wounds, has been promoted by experts in the field. However, there are few randomised, controlled clinical trials that clearly demonstrate the benefits of wound debridement (Piaggesi et al, 1998; Steed, 2004; Steed et al, 2006; Edwards and Stapley, 2010). Steed et al (2006) concluded that debridement of diabetic foot wounds was supported in the medical literature through papers on significant clinical series and expert opinion, but lacked multiple randomised clinical trials. Edwards and Stapley (2010) stated that previous studies on wound debridement lack appropriate sample size, are of poor quality and lack replication. Many studies agree, however, that debridement rids the wound of necrotic tissue that has a high likelihood of harbouring bacteria, therefore improving the body's ability to fight infection and effectively heal chronic wounds (Attinger et al, 2000; Armstrong et al, 2002; 2004; Steed et al, 2006).

There are several different forms of debridement that are employed today. There are specific risks and benefits associated with each technique. The goal of any form of wound debridement is multi-factorial and should include removal of:

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1. Effective debridement removes foreign material, including bacteria and prepares the wound for healing.
2. Sharp excisional debridement has been the gold standard for debridement techniques for years.
3. Avoid excessive bleeding when performing this form of wound debridement.

Figure 1. Wound pre-debridement.

Figure 2. Wound post-debridement.

nonviable or necrotic tissue, excessive surrounding hyperkeratosis, biofilm on the wound surface, and any foreign debris (dirt, grass, hair, etc; *Figure 1*). Appropriate debridement should also leave healthy tissue intact, avoid excessive bleeding, and promote efficient wound healing (Bekara et al, 2018; *Figure 2*).

The authors will not discuss all forms of wound debridement here, but will focus on four forms of effective debridement (sharp excisional, autolytic, enzymatic and maggot debridement therapy) that can be performed in the clinic setting without the need for expensive or specialised equipment. It should be noted, however, that there are specialised debridement instruments that can be used in an operating room or clinic setting, such as hydrosurgery, ultrasound, and coblation (Bekara et al, 2018). These techniques have been shown to selectively and rapidly debride necrotic tissue. They do require very specialised equipment that may not be available in most outpatient clinics, therefore, these therapies will not be directly addressed in this article.

Sharp excisional debridement with a sterile scalpel is still the gold standard for wound debridement. There have been papers that address appropriate wound debridement technique that the author would refer the reader to (Armstrong et al, 2002; 2004). In general, the goal of any debridement is to create a wound free of foreign debris, with a granular (red or bleeding wound surface), with no undermining or thick hyperkeratotic skin surrounding the wound (Attinger et al, 2000). The benefits of sharp excisional debridement are:

- Quick and efficient debridement that achieves the previously mentioned objectives
- A sterile scalpel, sharp scissors, curette, and Adson pickup are the only specialised instruments necessary to perform this debridement and they are readily accessible in the clinic setting and are inexpensive (Attinger et al, 2000)
- Allows the clinician to immediately assess the depth of the wound and which structures are involved: skin, subcutaneous tissue, tendon, muscle, joint capsule and bone.

The drawbacks to sharp excisional debridement are:

- The need for a highly skilled/trained practitioner to perform the debridement.
- This form of debridement may not effectively spare healthy tissue creating an uneven wound surface or create excessive bleeding (Bekara et al, 2018)
- The need for the patient to return for frequent debridement of their wound (this can be particularly prohibitive in remote locations where the patient may have to travel many miles to see their physician)
- This may require anaesthesia and a formal operating room setting, significantly increasing the cost of this therapy. However, this is less of a concern in neuropathic foot wounds because the patient cannot feel pain and this type of excisional debridement may be performed in an outpatient office setting.

Sharp excisional debridement is beneficial and has been a mainstay in diabetic foot wound care

despite the limitations listed above. In fact, many clinical studies evaluating different debridement techniques use sharp excisional debridement to establish a baseline for the wound at the initiation of the study (Tallis et al, 2013; Jimenez et al, 2017; Lantis and Gordon, 2017).

Autolytic debridement is performed by maintaining a moist wound environment, allowing the body's natural debriding process to take place (Mulder, 1995). This is often performed with hydrogels. Hydrogel dressings have been compared to wet-to-dry dressings for wound debridement (Eisenbud et al, 2003). While the latter has been shown to be inferior to hydrogel therapy it is still recommended in some clinical settings because of cost, ease of prescription, availability of dressing supplies, and lack of knowledge (Mulder, 1995; Cowan and Stechmiller, 2009). The authors will not discuss wet-to-dry dressings further in this article and would recommend other more effective modalities be employed.

The benefits of autolytic debridement are:

- It can be applied by someone with little training/experience with wound care, including the patient
- It can be performed without the direct supervision of the provider
- It can be placed on patients who are poor surgical candidates
- It is painless for patients who cannot tolerate sharp excisional debridement.

The drawbacks of autolytic debridement are:

- It cannot be used on clinically infected wounds
- Is contraindicated on soft or moist eschars
- It requires daily dressing changes.

Autolytic debridement can be an effective debridement tool in patients that are not healthy enough for surgical debridement under anesthesia, who cannot readily be transported to a clinic, or surgical setting where such debridement could be performed, or who has risk of excessive bleeding (anticoagulated) or severe peripheral vascular disease.

Enzymatic debridement is another debridement option. Clostridial collagenase ointment selectively removes detritus, while sparing healthy tissue. This then leads to the formation of granulation tissue that prepares the wound for keratinocyte and fibroblast proliferation and migration. This will, in turn, increase wound epithelialisation (Tallis et al, 2013).

Benefits of enzymatic debridement are:

- It is painless for those patients that cannot tolerate a sharp debridement
- It can be applied by someone with little training/experience with wound care, including the patient
- It can be performed without the direct supervision of the provider
- It selectively debrides only necrotic tissue (Shi and Carson, 2009).

Potential drawbacks to enzymatic debridement include:

- It is a slow process requiring days or weeks to fully debride the wound
- Excessive exudate is often present with this form of debridement (Attinger et al, 2000)
- The ointment is reasonably priced, but does have a cost and requires a prescription
- It requires daily dressing changes.

Enzymatic debridement is an effective adjunct therapy that can be used in the clinical setting in addition to sharp debridement. Sharp excisional debridement can be performed in the clinic and then, enzymatic debridement can be performed at the patient's home between clinic visits. This may allow the wound to remain clean and free of necrotic debris between visits, expediting wound closure.

Finally, maggot debridement therapy has been utilised in 'modern medicine' as a wound therapy for the past 85 years, but during the 1960s it fell out of favour with the use of antibiotics and better wound treatment options (Sherman, 2003). The benefits of maggot debridement, however, were noted as early as the 16th century by Ambroise Paré and then later by Baron Larrey and Joseph Jones, physician-in-chief to Napoleon's army and medical officer in the American Civil war, respectively (Mumcuoglu, 2001). There has been a resurgence of interest in maggot debridement therapy with multi-drug resistant bacteria, including methicillin-resistant *Staphylococcus aureus* (MRSA) (Mumcuoglu, 2001). One reason

for this new interest in maggot debridement therapy is its effectiveness against MRSA and other drug-resistant bacteria, as well as biofilms: specifically *Staphylococcus aureus*, and *Pseudomonas aeruginosa* biofilms (Van Der Plas et al, 2008).

Maggot debridement therapy does require some specialised dressing and of course medical grade maggots. There is one lab in the United States and two in Europe that produce such maggots and their dressings. These can be shipped to a specific clinic/hospital location overnight in most situations. This allows for rapid initiation of therapy once the need is established.

The benefits of maggot debridement therapy are (Mumcuoglu, 2001):

- Selective debridement of necrotic tissue
- Rapid effective debridement over hours to days
- Disinfects the wound, including biofilm and Gram-positive or Gram-negative bacteria
- Initiates granulation tissue formation
- Improves circulation to the wound.

The drawbacks to maggot debridement therapy:

- Psychological and esthetic apprehension to the therapy by patients, family and practitioners
- Escaping maggots can be disturbing to patients, family and medical staff
- The secretions, if the treatment is not applied properly can irritate the healthy surrounding skin. A skin barrier should be used.
- Patients may experience more pain during therapy
- Excessive drainage from the wound during therapy
- Excessive odour from the wound during therapy.

Maggot debridement therapy provides a viable option for effective debridement for any wound that is non healing. It is also a treatment for wounds that are not suitable for sharp debridement, such as with *Pyoderma gangrenosum*. Similar to autolytic and enzymatic debridement, maggot debridement therapy may be initiated after sharp excisional debridement. This will allow the wound to continue to be prepared for wound closure between office visits. Educating patients and medical staff on the benefits and risks of this therapy will break down the psychological and aesthetic apprehensions that limit its utility. This therapy may be even more useful in the future treating new antibiotic resistant bacterial strains. Furthermore, this therapy may be considered as a debridement option early in the clinician's wound care algorithm and not just as a final alternative to an impending amputation.

In conclusion, wound debridement is considered standard of care for diabetic foot wounds. There are multiple different modalities that effectively debride wounds, giving the clinician options to choose from depending on the risks and benefits of each modality, the needs of the patient, and the clinic and hospital settings. The clinician should evaluate the patient and the wound progress at each follow-up and determine which wound care dressing would be appropriate to prepare the wound for complete closure. This may mean using multiple debridement modalities concurrently.

Although there is very little doubt that debriding wounds is beneficial in accelerating healing, this understanding has been established through expert opinion, small clinical trials, and retrospective analyses. More research in the effects of wound debridement modalities, specifically large multi-centred, well-designed prospective, randomised, placebo-controlled clinical trials, will increase our understanding of its benefits and how they can be most effectively employed in the future. ■

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