**Introduction**

KerraContact™ Ag (Crawford) is an advanced wound contact dressing using Ag Oxysalts™ technology. It is the first dressing to use silver in its most chemically- and antimicrobially-active state (Lemire et al, 2015). This Made Easy outlines how Ag Oxysalts differs from other silver technologies and describes its unique mode of action, spectrum of activity, and potential role in biofilm reduction.

**Authors:** White R, Parker J

---

**INFECTION AND WOUND HEALING**

Infection is one of the main complicating factors in wound care. All wounds contain bacteria, but these become detrimental to healing if the wound moves from bacterial balance (organisms present but not invasive) to imbalance (critical colonisation and infection), where damage to tissue occurs (Sibbald et al, 2006). The capacity to resist bacterial invasion through the innate immune system, or ‘host’ response, is the single most important contributing factor.

What increases the risk of wound infections?

Infection is the result of pathogens successfully overcoming the defence strategies of a host. Diverse communities of microorganisms inhabit the outer surface of the human body, making up its normal flora. When a healthy patient has a wound, the host response effectively deals with any invading pathogens. Patients who are immuno-compromised, however, are more likely to develop an infection. The development of a wound infection is dependent on the pathogenicity and virulence of the microorganism, as well as the immune competency of the host (Heinzelmann, 2002).

How to recognise infection in chronic wounds

The following recommendations from The International Wound Infection Institute detail how to identify infection in chronic wounds (Swanson et al, 2015):

- **New or increasing pain**
- **Swelling, purulent discharge**
- **Pyrexia**
- **Delayed healing**
- **Abscess**
- **Malodour**

**LOCALISED INFECTION**

- New, increased or altered pain
- Delayed healing
- Periwound oedema
- Bleeding or easily damaged granulation tissue
- Distinctive malodour
- Wound bed discolouration
- Increased or altered/purulent exudate
- Induration, pocketing, bridging

**SPREADING INFECTION**

As with localised, plus:

- Wound breakdown
- Erythema extending from wound edge
- Crepitus, warmth, induration or discoloration spreading in periwound area
- Lymphangitis
- Malaise or other non-specific deterioration in patient’s condition

**SYSTEMIC INFECTION**

- Sepsis — documented infection with pyrexia or hypothermia, tachycardia, tachypnoea, raised or depressed white blood cell count
- Severe sepsis — sepsis and multiple organ dysfunction
- Septic shock — sepsis and hypotension despite adequate volume resuscitation
- Death

**ACUTE WOUNDS**

- Extension of erythema
- Lymphangitis
- Crepitus in soft tissues
- Wound breakdown/deshiscence

**CHRONIC WOUNDS**

- *e.g. diabetic foot ulcers, venous leg ulcers, arterial leg/foot ulcers or pressure ulcers*

**Figure 1:** Acute versus chronic wound infection (adapted from WUWHS, 2008)
species, protected against the immune system and antimicrobial agents (WWUH, 2008). Biofilms cause a chronic inflammatory response in acute wounds that results in an abundance of neutrophils and macrophages that secrete high levels of reactive oxygen species, proteases (MMPs), and elastase (Phillips, 2010). These help break down the attachments between the biofilm and wound tissue, dislodging the biofilm from the wound (EWMA, 2004).

However, in chronic wounds, biofilms are suspected to delay wound healing (James et al, 2008), because the response is not always successful in removing the biofilm. It is thought that this response may perpetuate rather than eliminate the biofilm, inducing an ineffective inflammatory response (Lawrence et al, 2007).

**What is the role of silver in infection management?**

Silver, in its metallic form (Ag\(^+\)), is unreactive and does not kill bacteria. To become bactericidal, silver atoms must lose an electron and become positively charged silver ions. Silver ions are highly reactive, affecting multiple sites in bacterial cells. They ultimately cause cell death by binding to bacterial cell membranes and causing disruption of the cell wall and cell leakage (Lansdown, 2002).

A number of silver dressings are available, with broad-spectrum antimicrobial activity that reduce bioburden and combat wound infection (Edwards-Jones, 2009; Carter et al, 2010; Toy and Macera, 2011; Aziz et al, 2012; Politano et al, 2013). In this respect, silver dressings have proven to be very effective (White et al, 2006; Leaper, 2006; Lo et al, 2009; Lipsky and Hoey, 2009). The advantages of topical antiseptics such as silver (antimicrobial agents that kill, inhibit or reduce the number of microorganisms present) over antibiotics are numerous. For example: localised antimicrobial wound therapy as opposed to whole body systemic exposure; immediate access to the wound bed in bactericidal concentration (even in the ischaemic limb); and antibiofilm activity.

Judicious use of topical antimicrobials plays a vital role in tackling wound bioburden and biofilm (Lipsky and Hoey, 2009). Moreover, the anti-biofilm activity of topical agents has been reviewed in vitro and silver is attributed with this advantage (Chung and Toh, 2014). This is an important distinction for chronic wounds where biofilm formation is strongly implicated in chronicity and recalcitrance (Cooper et al, 2014).

Evidence suggests an initial 2-week trial of treatment before the approach is re-evaluated, sometimes known as the ‘2-week challenge’. During this time, the efficacy of the silver dressing can be assessed, after which a decision can be made on whether to continue or discontinue its use (Wounds International, 2012; Dowsett 2014).

**UNDERSTANDING AG OXYSALTS**

Ag Oxysalts is a unique silver technology that is bactericidal, disrupts biofilms and prevents their reformation while also being cost-effective and patient-friendly (Crawford Healthcare, 2015).

**Why is Ag Oxysalts technology particularly effective at killing bacteria?**

Silver is only effective at killing bacteria when it is missing electrons and in its ionic state. The more electrons are missing, the more reactive it becomes and the greater its ability to disrupt the normal function of bacteria. Dressings with Ag Oxysalts technology are particularly effective at killing bacteria since they are designed with three electrons missing (Ag\(^{1+}\)), compared with other silver dressings that are only missing one electron (Ag\(^{2+}\)) (Figure 2) (Spina C, Crawford Healthcare, Data on File).

**Evidence for use of Ag Oxysalts technology**

Evidence for Ag Oxysalts technology derives from a number of studies, including a 50-patient multicentre study, a 20-patient case series, two in vitro studies, and an in vivo model (Table 1). Ag Oxysalts has been evaluated in terms of presence of infection indicators, antimicrobial activity, speed of kill, biofilm activity and pain reduction.

**Fast and effective at killing bacteria**

Ag Oxysalts technology is proven to quickly kill 99.999\% of a broad spectrum of bacteria (Crawford Healthcare, 2015) (Box 1).

### Table 1. Evidence for Ag Oxysalts technology

<table>
<thead>
<tr>
<th>Effectiveness</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective antimicrobial activity</td>
<td>In an in vitro study, Ag Oxysalts was effective against all of the tested wound pathogens</td>
<td>Lemire et al, 2015</td>
</tr>
<tr>
<td>Clinically effective in just 7 days</td>
<td>In a 50-patient multicentre study, a dramatic response was seen within 7 days</td>
<td>Motta et al, 2012</td>
</tr>
<tr>
<td>Fast speed of kill</td>
<td>In an in vitro study with known wound pathogens, a log 4 reduction was achieved in 4 hours or less (in a simulated wound fluid (SWF)), with a sustained effect over 7 days</td>
<td>Lemire et al, 2015</td>
</tr>
<tr>
<td>Effective against biofilms</td>
<td>In an in vitro study, organisms were grown in the Calgary biofilm device using peptone or SWF. The Ag Oxysalts dressing gave a log 7 reduction for both 24-hour and 72-hour biofilms</td>
<td>Miller et al, 2013</td>
</tr>
<tr>
<td>Progression to healing</td>
<td>Of 50 patients, 45% went on to heal within an average of 2.9 weeks</td>
<td>Motta et al, 2012</td>
</tr>
<tr>
<td>Reduced wound size</td>
<td>In a 20-patient case series of patients with chronic foot (n=10) or leg (n=10) ulcers, wound size reduced over an 8-week period for 16 stalled wounds with localised infection</td>
<td>Sibbald R et al, 2012</td>
</tr>
<tr>
<td>Reduced pain</td>
<td>In a 20-patient case series, pain scores reduced dramatically over treatment (cumulative pain scores: week 0=44.5; week 8=33)</td>
<td>Sibbald R et al, 2012; Motta et al, 2012</td>
</tr>
<tr>
<td>Patient comfort</td>
<td>The Ag Oxysalts dressing demonstrated only a nominal shift in pH (pH levels are altered by increased bacterial load, which can cause irritation and pain), at a markedly lower silver concentration compared with most competitors; patients experienced minimal pain with increased comfort, without compromise on biocidal effectiveness. In a 50-patient multicentre study, 93% of patients reported reduced wound pain, with no pain at dressing application and removal</td>
<td>Exciton Technologies, 2009; Motta et al, 2012</td>
</tr>
</tbody>
</table>
KerraContact Ag uses Ag Oxysalts technology, which is designed with three missing electrons (Ag3+), while other silver dressings are only missing one electron (Ag1+)

This makes KerraContact Ag particularly effective at killing bacteria.

**What is KerraContact Ag?**

KerraContact Ag is a unique silver wound dressing that utilises Ag Oxysalts technology, which acts quickly (within 1 week) against bacteria and destroys biofilms. This speed of response means that instead of aiming for a ‘2-week challenge’, clinicians can assess wounds for reduction in the signs and symptoms of infection after just 1 week. KerraContact Ag has also proven safe and gentle for patients with wounds of various aetiologies.

The composition and properties of KerraContact Ag are shown in Figure 3.

**Indications for use**

KerraContact Ag can be used for acute and chronic wounds that are locally infected or at high risk of infection, including burns, leg ulcers, pressure ulcers, diabetic foot ulcers, and surgical wounds (Crawford Healthcare, 2015). Also, in the stage between colonisation and infection referred to as critical colonisation or localised infection (WUWHS, 2008), the use of an antimicrobial dressing such as KerraContact Ag should be considered (Wounds UK, 2013). KerraContact Ag can also be used immediately following debridement if a biofilm is suspected (Dowsett, 2013).

The case study on page 4 highlights the benefits of using KerraContact Ag in a patient with a chronic venous leg ulcer.

**How to apply KerraContact Ag**

If KerraContact Ag is indicated, it can be used on any type of wound following a detailed holistic assessment, unless there is a known allergy to any of its ingredients. KerraContact Ag can be applied directly to the wound bed. The silver does not need to be activated in any way (i.e. it does not need to be moistened). It can be cut to wound size and shape. A secondary dressing will be indicated in the majority of cases. The dressing will need to be changed as often as clinical assessment suggests at each dressing change, but can be left in situ for up to 7 days.

**Destroys biofilms**

Ag Oxysalts disrupts and breaks down the biofilm, exposing bacteria to be killed. In an in vitro study, mature biofilms of Pseudomonas aeruginosa and Staphylococcus aureus were grown and treated. No viable bacteria was retrieved after 24 hours. The biofilms had been disrupted allowing the bacteria to be killed quickly and effectively (Miller et al, 2013).

**WHAT IS KERRACONTACT AG?**

KerraContact Ag is a unique silver wound dressing that utilises Ag Oxysalts technology, which acts quickly (within 1 week) against bacteria and destroys biofilms. This speed of response means that instead of aiming for a ‘2-week challenge’, clinicians can assess wounds for reduction in the signs and symptoms of infection after just 1 week. KerraContact Ag has also proven safe and gentle for patients with wounds of various aetiologies.

The composition and properties of KerraContact Ag are shown in Figure 3.

**Indications for use**

KerraContact Ag can be used for acute and chronic wounds that are locally infected or at high risk of infection, including burns, leg ulcers, pressure ulcers, diabetic foot ulcers, and surgical wounds (Crawford Healthcare, 2015). Also, in the stage between colonisation and infection referred to as critical colonisation or localised infection (WUWHS, 2008), the use of an antimicrobial dressing such as KerraContact Ag should be considered (Wounds UK, 2013). KerraContact Ag can also be used immediately following debridement if a biofilm is suspected (Dowsett, 2013).

The case study on page 4 highlights the benefits of using KerraContact Ag in a patient with a chronic venous leg ulcer.

**How to apply KerraContact Ag**

If KerraContact Ag is indicated, it can be used on any type of wound following a detailed holistic assessment, unless there is a known allergy to any of its ingredients. KerraContact Ag can be applied directly to the wound bed. The silver does not need to be activated in any way (i.e. it does not need to be moistened). It can be cut to wound size and shape. A secondary dressing will be indicated in the majority of cases. The dressing will need to be changed as often as clinical assessment suggests at each dressing change, but can be left in situ for up to 7 days.

**Destroys biofilms**

Ag Oxysalts disrupts and breaks down the biofilm, exposing bacteria to be killed. In an in vitro study, mature biofilms of Pseudomonas aeruginosa and Staphylococcus aureus were grown and treated. No viable bacteria was retrieved after 24 hours. The biofilms had been disrupted allowing the bacteria to be killed quickly and effectively (Miller et al, 2013).
CASE STUDY (Clinician: Rachel Parker)
A 79-year-old female presented with a 4-year history of bilateral venous leg ulcers. Both legs were ulcerated from the toe to the knee, with a high level of exudate, pain at dressing change, and malodour. Her wounds were infected (MRSA and Pseudomonas aeruginosa). She had a history of myocardial infarction, arthritis, and osteoporosis.

Treatment
The patient was treated with KerraContact Ag for 7 days, with the aim of treating the infection, with KerraMax Care used as a secondary dressing.

Outcomes
After 7 days, the wound appeared drier, cleaner and less inflamed, and the surrounding erythema had reduced. Reductions were seen in levels of exudate (significant reduction), odour, and swelling, and the surrounding erythema had reduced. Reductions were seen out of 5 for overall improvement in the condition of the wound. The patient reported that KerraContact Ag was extremely easy to apply and remove. Fewer dressing changes were required compared with previous treatment, reducing the discomfort of dressing change.

REFERENCES
Crawford Healthcare (2015) Introducing the world’s most advanced silver dressing. KerraContact,™ KerraMax Care™ and KerraFoam™ are trademarks of Crawford Woundcare Ltd. Ag Oxysalts™ is a trademark of Exciton Technologies.

AUTHOR DETAILS White R*, Parker J*

1. Clinical Editor, Wounds UK; Professor of Tissue Viability, University of Worcester and Director of Plymouth Wound Care
2. Tissue Viability Lead Specialist Nurse, The Queen Elizabeth Hospital King’s Lynn NHS Foundation Trust

KerraContact Ag is a registered trademark of Crawford Healthcare. KerraContact™, KerraMax Care™ and KerraFoam™ are trademarks of Crawford Woundcare Ltd. Ag Oxysalts™ is a trademark of Exciton Technologies.