

Technology update: Understanding Hydrofiber® Technology

Modern wound care clinicians have witnessed the development of a bewildering array of new technologies, many of which have emerged as a result of the failings of previous products. One of the more successful recent advances has been the introduction of Hydrofiber® Technology. Hydrofibers are one of the most widely used modern wound care dressings and this article examines their qualities and the evidence for their efficacy.

INTRODUCTION

In the past many different materials have been used in the treatment of wounds, ranging from grease-soaked bandages to what can best be described as 'sophisticated' cloths or gauzes. Traditionally wound care was the remit of surgeons or doctors but the specialty has now expanded to include nurses and other healthcare professionals. This increasingly multidisciplinary approach has been aided by the evolution of other clinical areas such as endocrinology and diabetes and treatment options have become increasingly sophisticated.

One of the most influential figures in the evolution of wound treatment was George Winter[1]. Up until the 1960s, traditional practice dictated that clinicians use gauze to 'soak up' any wound fluid then allow the wound to dry out, scab over and ultimately heal. That was until Winter discovered that keeping the wound moist led to faster and better healing. As a result of Winter's work researchers and clinicians in the 1970s[2] began to develop newer dressings out of plastics, with the first film dressings utilising polyurethane technology[3]. During the 1980s, a better understanding of the limitations of film dressings led to the development of alternative technologies, such as alginate and hydrocolloid dressings, with each new product building on the developments that had gone before[4]. In the 1990s Hydrofiber® Technology was introduced leading to significant changes in practice.

HYDROFIBERS

A Hydrofiber is defined as a soft, sterile, non-woven pad or ribbon dressing composed of sodium carboxymethylcellulose, which is incorporated in the form of a fleece held together by a needle-bonding process. This conformable material can absorb a large amount of wound fluid, such as exudate with bacteria. This is then transformed into a soft gel, which creates a moist environment to support the body's healing process. The gel also aids the removal of non-viable tissue from the wound (autolytic debridement), without damaging newly formed tissue. Hydrofibers are versatile and can be incorporated into a variety of dressing formats[5].

Hydrofibers are neither hydrocolloids nor alginates, but a separate category incorporating the benefits

of both, while also addressing their weaknesses (eg cohesive gelling, aggressive adhesion etc). As the term Hydrofiber has been trademarked, similar dressings cannot refer to themselves as Hydrofibers and as such this category may become renamed as it expands. However, since all of the pioneering work in this category has so far been driven by Hydrofiber Technology, Hydrofibers will be the focus of this review.

The first Hydrofiber dressing to be launched was Aquacel® (ConvaTec) in 1997[6]. By the mid-2000s new formulations were introduced for different clinical situations[7] and these now include the addition of antimicrobial ionic silver, or the use of Hydrofiber as a specific layer in composite dressings. Hydrofiber dressings also come in a variety of formats for different wound types and situations, for example Aquacel Hydrofiber ribbon can be used in deep cavity wounds. Different shapes and sizes of dressings are also produced for specific anatomical areas.

BRANDS

The main brands of Hydrofiber dressing are Aquacel, Aquacel Ag and Versiva® XC™ (ConvaTec).

Aquacel Ag is a silver-impregnated antimicrobial dressing that contains 12mg of silver per 10 x 10cm² of dressing[8]. Like any Hydrofiber it absorbs exudate to form a soft, hydrophilic, gas permeable gel[8] but also provides a barrier to bacterial penetration and helps to reduce infection[9] through a sustained release of silver ions, which can last for up to 14 days[10].

Versiva XC has an absorbent core consisting of a layer of sodium carboxymethylcellulose fibres placed upon a thin sheet of polyurethane foam/film laminate. The wound contact surface of the dressing is coated with a perforated layer of a hydrocolloid adhesive that extends to the outer margins of the dressing[8]. Versiva XC traps wound fluid and prevents lateral leakage or backflow into the wound, even under compression[11]. The outer foam/film layer is permeable to moisture vapour, which further enhances the fluid-handling properties of the dressing, whilst providing an effective bacterial/viral barrier[12]. Versiva XC is manufactured to be easy to remove without causing pain or trauma and leaves minimal residue on the wound surface[13].

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EVIDENCE

Hydrofiber Technology can be used in moderately-to-highly exuding chronic and acute wounds and provides:

- A moist wound environment to support healing[8]
- Excellent absorption and retention[14]
- Protection for periwound skin
- Reduced maceration[15,16]
- Reduced cross-contamination on dressing removal[17]
- Balanced inflammatory response[18].

Much of the research into Hydrofiber dressings focuses on their mechanism of action. By default this has led to the expansion of the scientific knowledge around wounds and the management of exudate[19].

Absorbency

A key feature of Hydrofiber dressings is the ability to absorb and contain wound fluid[20]. This means that wound exudate and any pathogenic bacteria that it may contain[20], is removed from the wound bed and the periwound area, protecting them from potential maceration[15,16] and providing passive infection control[21]. Furthermore, this action can minimise the release of bacteria into the air on dressing removal[20]. This unique 'locking in' action makes dressings with Hydrofiber Technology more effective at retaining fluid than traditional gauze or alginate dressings[22].

Conformable

Once a Hydrofiber® dressing has transformed into a gel, it is able to contour closely to the wound bed[18]. This means that there are no gaps at the wound-dressing interface, limiting the amount of space for bacteria to proliferate[18].

Responsive

Another key feature of dressings with Hydrofiber® Technology is the ability to respond to different wound conditions through their gelling action. For example, in acute healing wounds this creates a moist wound environment[23], whereas in chronic wounds it maintains a moisture balance, ensuring the wound is neither too wet nor too dry[23]. In partial thickness wounds Hydrofiber dressings are able to respond to the uptake of fibrin, ensuring adherence to the wound and forming a protective barrier[18]. The addition of silver, as in Aquacel Ag, provides a reservoir of silver ions[24,25] inside the dressing which responds to changes in the components of the wound fluid. *In vitro* tests have demonstrated that the dressings are able to increase the silver ion availability 'on demand'[24,25], thereby helping to combat infection.

Wicking

In vitro tests have also demonstrated the hydrophilic properties of Hydrofiber dressings and their

ability to absorb fluid from a petri dish (representing the wound bed), wicking it away from the surface. Importantly, the fluid did not wick laterally across the length of the dressing, but remained confined to the fluid-soaked area, unlike conventional dressings (eg gauze or alginate), where the fluid is wicked laterally across the dressing. In a clinical setting, this ability to lock in fluid may help prevent maceration by limiting the lateral spread of wound fluid[15,16].

Sequestration

It has been demonstrated that the ability to form a cohesive gel makes Hydrofiber dressings more able to lock in fluid than conventional gauze and alginate dressings[15,16]. Each was successively exposed to a range of dyed fluids, which were used to represent exudate. The dressing incorporating Hydrofiber Technology locked in each fluid in turn, with no bleeding of one into the next. By contrast, the traditional materials largely fail to lock in the fluids, which mixed freely within the dressings.

Pressure

The locking in action of Hydrofibers is particularly useful in the treatment of venous leg ulcers where compression is the mainstay of treatment. In one test, Versiva XC was saturated with fluid to simulate a dressing that had absorbed a large amount of exudate. It was then placed under a 5kg weight to mimic the equivalent of 40mmHg pressure[26]. After a specified time period, the weight was removed. Despite the pressure, the Versiva XC retained all of the absorbed fluid and also prevented any lateral spread. In contrast, two foam dressings that were also tested failed to retain the fluid.

Intimate contact

As a result of the transformation into a soft coherent gel on contact with fluid, Hydrofiber Technology is able to contour over the wound and prevent exudate pooling at the wound interface. Moreover, this means the dressing can maintain a continuous moist environment across the wound that provides comprehensive healing[27]. In vitro data has shown that upon hydration Hydrofiber Technology effectively follows the contours of a simulated wound bed, especially in comparison to alginate or foam dressings[28].

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CLINICAL USE

Indications

Dressings containing Hydrofiber Technology are supported by over 65 published articles[29], including:

- Seventeen randomised controlled trials
- Thirteen other clinical studies
- Three animal studies
- Twenty scientific publications
- Fifteen review papers and case studies.

Hydrofibers may be used for the management of exuding wounds including:

- Venous, pressure and diabetic ulcers
- Surgical wounds
- Partial thickness burns
- Traumatic wounds
- Oncology wounds.

Application

Individual manufacturers' labelling and application instructions should be consulted before using any Hydrofiber dressings to ensure the most efficient and safe use.

INDIVIDUAL HYDROFIBER DRESSINGS

Aquacel

Aquacel demonstrates the following properties (some demonstrated in vitro):

- Creates a moist wound environment to support healing
- Promotes absorption and retention[14]
- Protects periwound skin and reduces maceration[15,16]
- Minimises cross-contamination on dressing removal[17]
- Balances the inflammatory response[18]
- Minimises pain during wear and at dressing removal[30,31]
- Provides ease of application and removal
- Provides a seven-day wear time.

Application guidelines for Aquacel dressings include:

- Dressings should be applied with a 1cm overlap onto the skin surrounding the wound
- When using Aquacel Hydrofiber ribbon in deep cavity wounds, a length of at least 2.5cm should be left outside the wound for easy retrieval. Deep wounds should only be packed up to 80% of their volume as the dressing will expand to fill any spaces on contact with wound fluid
- Apply the dressing to the wound and cover with a secondary dressing
- Aquacel dressings should be removed when clinically indicated (eg in the presence of leakage, excessive bleeding, or suspicion of infection).

Evidence

In a 12-week evaluation of 131 community patients with leg ulcers, Aquacel demonstrated better results than other dressings in terms of overall performance, wear time and cost-effectiveness[32]. In wounds of mixed aetiology, Aquacel achieved healing or substantial healing in over 75% of patients after just four weeks. It also reduced pain during treatment and on removal and resulted in fewer dressing changes compared with patients that had previously been managed with other dressings[32].

Another prospective randomised controlled trial of 183 patients who had undergone orthopaedic surgery compared Aquacel that was covered with Tegaderm™ (3M) against another dressing. The Aquacel was 5.8 times more likely to result in a complication-free wound ($p < 0.00001$)[33].

Aquacel Ag

Aquacel Ag combines Hydrofiber Technology with the benefits of ionic silver and can be used in moderately-to-highly exuding chronic or acute wounds that are infected or at risk of infection. Aquacel Ag provides:

- A moist wound environment to support healing
- Absorption and retention[14]
- Protection for the periwound skin and a reduction in maceration[15,16]
- On-demand antimicrobial activity within the dressing[25]
- Broad spectrum antimicrobial activity[25]
- Sustained antimicrobial activity[25,34]
- Reduced cross-contamination on dressing removal[20]
- Balanced inflammatory response[18]
- Reduced pain during wear and at dressing removal[30,31]
- Ease of application and removal[35]
- Seven-day wear time[27]
- Fourteen-day antimicrobial activity[34].

Evidence

A prospective multicentre study of 134 patients with non-ischæmic diabetic foot ulcers compared Aquacel Ag with a calcium alginate dressing. The study found that Aquacel Ag reduced average healing time and healed or improved more patients ($p = 0.058$) over an eight-week period[36]. Another randomised prospective multicentre study examined 82 patients with burns for 21 days. Aquacel Ag dressing was compared to a standard treatment of silver sulfadiazine cream under a gauze dressing. In patients with partial thickness burns, Aquacel Ag was associated with less pain and anxiety at dressing change, fewer dressing changes, less nursing time and fewer procedural medications[37].

Versiva XC

Versiva XC dressing provides clinicians and patients with all the benefits of Hydrofiber Technology with an added waterproof backing that acts as a barrier against bacteria and viral pathogens, such as human immunodeficiency virus (HIV) and hepatitis. Versiva XC can be used in moderately to highly exuding chronic and acute wounds[38]. Versiva XC dressing is the only dressing specifically designed to act as a secondary dressing over Aquacel and Aquacel Ag.

Evidence

It has been demonstrated that Versiva XC can help wounds progress toward healing[26,39,40]. In a prospective non-comparative four-week clinical study of 46 exuding leg ulcer patients[39], there was a significant reduction in mean wound area from 10.1cm² to 5.1cm² (p<0.001) and five patients' wounds healed completely (11%). There were also improvements in the surrounding skin and ulcer pain.

In another prospective, noncomparative four-week study of 23 patients with an average pressure ulcer duration of one year[40], 61% of clinicians reported that the wound condition had either healed or improved and more than 90% of responsive subjects rated Versiva XC as 'cushioning', 'soothing' and 'comfortable'. Patients' skin condition either healed, improved or remained stable in 87% of cases and 91% of clinicians rated Versiva XC as 'excellent' or 'good' when assessing non-traumatic dressing removal.

THE FUTURE

Hydrofibers are one of the most widely used dressings for the treatment of acute and chronic wounds and their level of sophistication has increased to cope with diverse clinical situations.

So far, Hydrofiber Technology has benefited from a strong patent that has prevented similar products from entering the market. However, several products, claiming to deliver the same benefits (eg Durafiber [Smith & Nephew] and ActivHeal AquaFiber® [Advanced Medical Solutions Group]) have recently been launched. As this market develops, clinicians may see the emergence of a new dressing category called 'gelling fibres' along with different sub-categories (which ironically may include alginates).

To date, however little if any clinical evidence has been published to substantiate how close these new products are to Hydrofibers and further evidence is required to demonstrate their utility.

The future application of Hydrofibers and similar technologies will continue and evolve to meet new

clinical challenges. While Hydrofibers, like all dressing technologies, may not be optimal for all wounds, they are highly effective in many.

Author Details



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