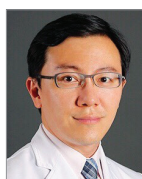


# A new approach to the debridement and treatment of chronic wounds in Hong Kong and Taiwan



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As is the case in many countries worldwide, chronic wounds are a major healthcare burden in Asia and provide significant clinical challenges for healthcare workers. Devitalized tissue (slough and eschar) is particularly prevalent in chronic wounds, delaying their healing. Critical to the successful treatment of these wounds is the removal of the devitalized tissue by debridement and the preparation of the wound bed to enable healing progression. This report documents the use of HydroClean® mini in the treatment of six patients with a variety of chronic wounds and shows how this dressing effectively debrided the wounds, supporting wound bed preparation and healing advancement.

**A** chronic wound occurs when there is a failure in the normal processes that lead to healing. Although difficult to define precisely, wounds that do not heal within 4 weeks to 3 months are termed “chronic” (Järbrink et al, 2016). These wounds have a significant negative impact on the patient’s quality of life, in that they are painful and debilitating (Green et al, 2014). Chronic wounds are generally classed according to the wound’s underlying pathological processes (e.g. diabetic foot ulcer, venous leg ulcer, pressure ulcer) (Kirsner, 2016, which are often associated with age. This means that as a consequence of the ageing population, there is likely to be a significant increase in the number of people suffering from chronic wounds. Therefore, developing effective methods to treat chronic wounds is of paramount importance (Sgonc and Gruber, 2013).

It has been estimated that in developed countries 1–2% of the population will experience a chronic wound during their lifetime (Gotttrup, 2004). A recent systematic review and meta-analysis of published observational studies on the prevalence of chronic wounds in the general population, undertaken by Martinengo et al (2019) showed that a pooled prevalence for chronic wounds of mixed aetiologies was 2.21 per 1,000 population and 1.51 per 1,000 population for chronic leg ulcers. These statistics are broadly in line with the findings in studies carried out in East Asia.; for example, in a study

examining 17 hospitals in China, the prevalence of chronic cutaneous ulcers among patients was 1.7 per 1,000 (Jiang et al, 2011). One of the leading causes of ulceration was found to be diabetes and this reflects the larger picture of diabetic ulcers being a particular problem. In a large cohort study of 1,333 patients, the annual incidence of ulceration in patients with diabetes mellitus was found to be 8.1% (Jiang et al, 2015). However, regional variations confuse the data; in a study of 241 patients with chronic wounds in Shanghai, the most common cause of these wounds was found to be traumatic or surgical wounds (Sun et al, 2017). The prevalence and incidence of leg ulcers in Hong Kong (and Taiwan) is not well documented (Wong, 2002) but a study of 819 patients receiving community care found that 200 (24%) were receiving wound care (Wong, 2002). Of these patients, 94 (47%) had ulcers on their lower limb (but nurses had not noted the cause of the wounds). Chronic cutaneous ulcers are a major healthcare burden in countries of East Asia and as the population is ageing and other risk factors, such as the prevalence of diabetes are rising, the demands on wound care are also likely to increase (Bao et al, 2018).

Leg ulcers provide significant clinical challenges that have to be managed in order for healing to progress. These include increased exudate production, wound deterioration, wound pain and the presence of devitalized tissue that delays healing (Wong, 2002; Frykberg and Banks, 2015). The cleansing and

**Table 1. Patient demographics**

Patient	Gender	Age	Wound type
1	Male	55	Diabetic foot ulcer
2	Male	32	Diabetic foot ulcer
3	Male	3	Non-healing traumatic wound
4	Male	85	Carbuncle (abscess)
5	Female	82	Pressure ulcer
6	Female	88	Venous leg ulcer

**Case report 1. A 55-year-old male with diabetic foot ulcer**



Day 0



Day 6 (with HydroClean dressing in situ)



Day 16



Day 26

**Patient history:** This 55-year-old male, with a 10-year history of diabetes and previous episodes of ulceration, initially presented with ulceration after he received a trauma from a sharp object, that had lacerated the sole of his foot whilst out walking. He was admitted to hospital due to infection, where surgery followed to remove some bone. This resulted in a large wound that was treated with normal saline and wet gauze dressings, which were changed 3 times per day. There was no improvement.

**Treatment with HydroClean®:** 2 days later, HydroClean® treatment started. After approximately 12 days, the wound had shrunk and treatment with HydroClean® mini

was started. The wound showed signs of improvement with granulation tissue formation and wound closure. After 26 days of HydroClean® and HydroClean® mini treatment, the wound reduced in area and depth, decreasing from 4 cm x 2.3 cm x 3 cm to 1.8 cm x 0.5 cm x 0.2 cm without any complications. HydroTac was then used to progress wound healing further. The patient was discharged from hospital after 26 days.

**Outcomes:** Exudate was managed effectively throughout the course of the treatment and dressing changes were atraumatic, with no signs of dressing adherence. Hyper-hydration of peri-wound skin was seen but this did not affect wound progression. The wound

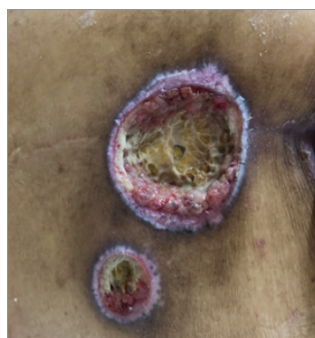
debridement (including necrosis, eschar, slough) of ulcers is seen as crucial for effective healing (Strohal et al, 2013). Wound debridement can be achieved via a number of techniques (e.g. mechanical, surgical, enzymatic). However, one favoured technique is autolytic debridement, a natural process by which devitalized tissue is removed using the body's own processes. This process is supported and enhanced by wound dressings that promote a moist wound environment (Atkin, 2014). Hydro-responsive wound dressings (HRWD) are a group of dressings that have been shown to provide rapid and painless wound debridement (Spruce

et al, 2016; Hodgson et al, 2017) and provide an optimal environment for healing progression (Atkin and Ousey, 2016; Atkin and Rippon, 2016). This study presents a case series of patients with chronic wounds who were treated with the HRWD (HydroClean® mini) to promote wound debridement and subsequently enable their healing progression.

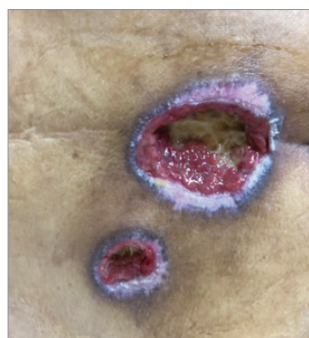
### Methods

This was a retrospective, open-label, non-comparative, multi-center audit of both in- and out-patients. All six patients treated with HydroClean® mini had been selected by the

### Case report 2. A 82-year-old female with sacral pressure ulcer



Day 0



Day 11



Day 21

**Patient history:** A bedridden 82-year-old female, with a clinical history of diabetes and dementia, presented to the department of Internal Medicine because of her hypoglycaemia. At this point, two unstageable pressure ulcers in the sacral area were discovered that had no previous treatment. The patient had not undergone any pressure ulcer prevention regimen. After sharp debridement, the larger pressure ulcer, which could now be defined as stage 4, was treated for 2 weeks with Sulfasil (1% silver sulfadiazine cream), but showed limited progress in healing and the wound edge appeared macerated and thickened/rolled. The wound edges were very violaceous.

**Treatment with HydroClean®:** HydroClean®mini was applied to the smaller pressure ulcer and HydroClean® applied to the larger wound. Over the course of 21 days, significant debridement of the wounds occurred, with the level of slough coverage reducing from

approximately 80% to 30%. Wound inflammation was reduced and by Day 21 the wound bed was moist and healthy. The wound edge, which appeared macerated at the start of treatment, also appeared healthy and signs of new epithelial growth was visible. Over the course of the 3 weeks observation, the wound size (for the larger ulcer) reduced from 8 cm x 10 cm x 2 cm to 5.5 cm x 7 cm x 1.5 cm.

**Outcomes:** The HydroClean®/HydroClean®mini dressings both effectively managed wound exudate and were easy to apply and remove. There were no signs of dressing adherence to the tissue. Peri-wound skin condition was good with no indications of maceration. The initial thickened/rolled wound edges were smoothed with treatment of HydroClean®. Hypergranulation of the wound bed was gradually replaced with a healthy moist wound bed, and new epithelial tissue was observed after 1 week.

Clinical Investigator(s) according to whether their wounds required debridement in order to remove devitalized tissue.

HydroClean®mini is a 3 cm diameter HRWD pad containing superabsorbent particles (for high absorbency) activated with Ringer's solution (a physiological saline solution), that creates a moist wound environment and removal of devitalized tissue by autolytic debridement. HydroClean®mini is indicated for use in the treatment of small and cavity wounds (e.g. venous leg ulcers, diabetic foot ulcers and pressure ulcers) that require exudate management and debridement in order to enable wound bed preparation and support wound healing progression.

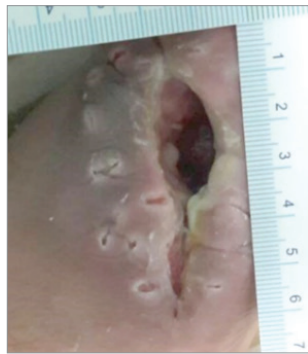
Having obtained consent, suitable patients were started on treatment with HydroClean®mini. Each patient was treated according to the local clinical routine and the evaluation period lasted until the wounds were fully debrided and/or following a healing trajectory. All dressings were applied according to the manufacturer's instructions and the patient's individual clinical

requirements. Patients were assessed at baseline (commencement of the evaluation period) and again at subsequent dressing changes according to clinical needs. A retrospective analysis of the data allowed for a comparison to be made of the status of the wounds at baseline, versus that at the end of the treatment evaluation period.

### Results

We describe six cases in which a variety of non-healing/chronic wounds were successfully treated with HydroClean®mini. Two expanded case reports detailing the treatment and response of difficult-to-heal wounds to HydroClean®mini are presented in *Case reports 1 and 2*, while the other four are summarised and depicted in *Case reports 3 to 6*. All six patients had non-healing wounds, four patients were male and two were female. The mean age was 57.5 years (SD 34.4 years) with a range from 3 to 88 years [Table 1]. The case studies presented here show that in all of the patients treated, the primary objective of using HydroClean®mini (to cleanse the wound bed and enable removal of devitalized tissue by debridement) was

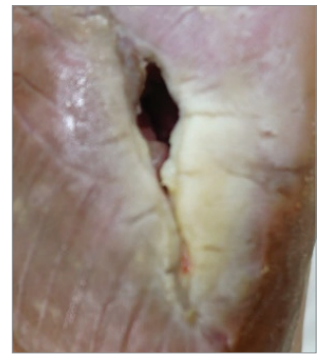
## Case report 3. A 32-year-old male with diabetic foot ulcer with history of osteomyelitis



Day 0



Day 15



Day 28

## Case report 4. A 3-year-old patient with non-healing traumatic wounds



Day 0



Day 7



Month 2

highly successful and that good wound bed preparation and subsequent progression to a fully healed wound or a reduction in its size occurred. Feedback from the clinicians was good in that they often reported fewer dressing changes were required with HydroClean<sup>®</sup>mini, when compared against previous treatment regimens. Overall it was reported that generally the dressings were found to be easy to use and could be applied to wounds in awkward places.

### Case study 3

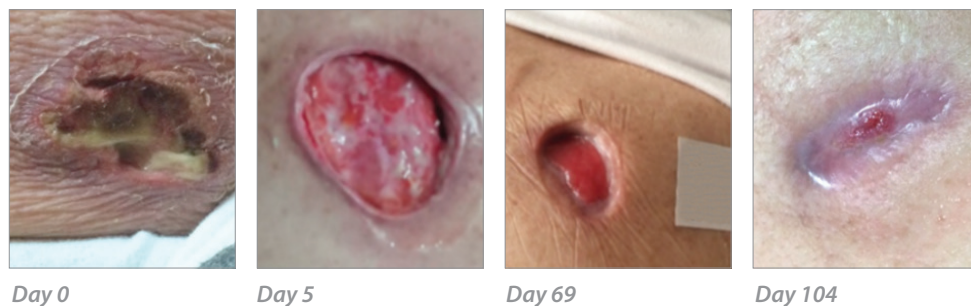
A 32-year-old male with a 20-year history of diabetes and 3 years of end-stage renal disease had been hospitalized as a result of a diabetic foot ulcer on his left foot. The wound deteriorated and osteomyelitis developed which required surgery. Several attempts were made to promote wound healing including negative pressure wound therapy, but wound healing did not progress after 1 month of this treatment. The wound showed high exudate levels, clinical signs of infection and biofilm formation. This was subsequently treated with oral antibiotics and the wound managed with HydroClean<sup>®</sup> cavity (changed every 3–4 days). A reduction in the level of infection was seen after only two applications of the dressing and the wound size reduced from

6 cm x 2.5 cm x 2.2 cm to 1.2 cm x 0.8 cm x 0.5 cm within 28 days of treatment. Healing was well advanced after 42 days. Once the wound depth had reduced, HydroClean<sup>®</sup> was replaced with HydroClean<sup>®</sup>mini to optimize the environment for healing. The high level of exudate was managed well by HydroClean<sup>®</sup>/HydroClean<sup>®</sup>mini, which the clinician reported as easy to apply and remove, with no trauma to the wound bed or peri-wound skin. It is important to note that prior to treatment with HydroClean<sup>®</sup>mini the patient had spent 2.5 months in hospital, but because of the significant improvements in the wound and the ease of application of HydroClean<sup>®</sup>, the patient was discharged after 17 days (dressing changes were performed by a renal dialysis unit nurse).

### Case study 4

A 3-year-old male patient presented with 2 traumatic wounds over the left ankle, after sustaining an injury whilst riding a bicycle. The wounds had not progressed satisfactorily for 3 weeks since the accident despite daily treatment. The smaller wound was a partial-thickness wound (1 cm x 0.4 cm) in size and the larger one, a deeper partial-thickness wound (1.4 cm x 0.9 cm) in size. Both wounds contained slough but the status of the peri-wound skin

#### Case report 5. A 85-year-old male with a carbuncle (abscess) wound



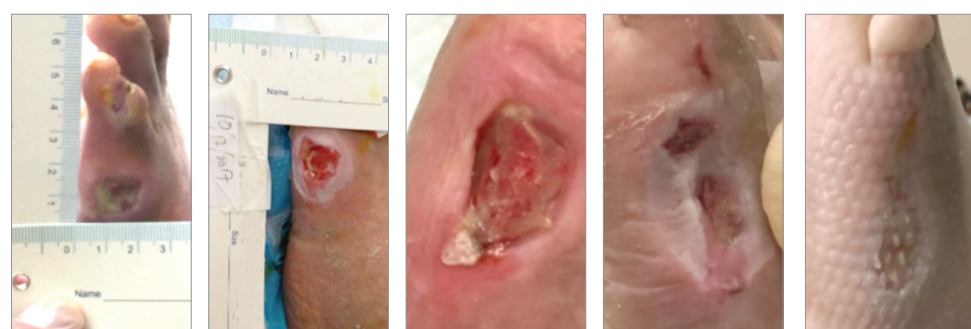
Day 0

Day 5

Day 69

Day 104

#### Case report 6. A 88-year-old female with foot ulcers



Day 0

Day 26

Day 78

Day 246

Day 324

appeared good. The larger wound was treated with HydroClean®mini, whereas the smaller wound was treated with HydroTac® transparent (a transparent hydrogel sheet). Treatment of the wound with HydroClean®mini resulted in debridement of the wound bed and the development of healthy granulation tissue by Day 7. Hyper-hydration of the peri-wound skin was observed at this time but this did not affect wound progression and the wounds healed without incident.

#### Case study 5

An 85-year-old male presented with a carbuncle (abscess) wound on his left shoulder. The wound bed was covered with necrotic tissue and dry, fibrinous tissue. The wound was surgically debrided to remove the majority of the devitalized tissue but remnants of slough were still retained within the wound bed. Five days after surgical debridement, HydroClean®mini was applied and changed daily. Treatment with HydroClean®mini treatment resulted in rapid debridement of the sloughy tissue, and subsequent development of a wound bed with healthy granulation tissue. As can be seen in the clinical pictures, within ten weeks of treatment there was a marked improvement, in that there was reduction in the

wound size and by 19 weeks the wound was almost completely healed.

#### Case study 6

An 88-year-old female under the care of a nursing home, and with a history of peripheral vascular disease and congestive heart failure, had her right leg amputated in April 2016, after suffering from an episode of acute cellulitis and gangrene. She had ulcers on her left foot (medial and lateral ulcers) since 2015 (treatment included Betadine (Povidone-iodine) and foam dressings) and orthopaedic doctors recommended amputation. The patient had been admitted to hospital several times for a number of medical conditions and her wounds had deteriorated upon discharge. Treatment with HydroClean®mini first began in November 2017, and was restarted on both areas whenever the ulcers deteriorated. The clinical pictures shows the progress of a left lateral wound with treatment of HydroClean®mini. The wound presented with significant levels of sloughy fibrinous material, and a rapid improvement in the wound bed could be seen, with a reduction in sloughy tissue and a corresponding increase in healthy granulation tissue. Sharp debridement was then possible to further improve the wound bed. The

subsequent deterioration of the wound after interruption of HydroClean®mini treatment resulted in an enlargement in the wound area. HydroClean®mini treatment was recommenced again. This led to the debridement of the wound bed, wound progression and a significant reduction in wound area.

## Discussion

The removal of devitalized tissue from a wound is a prerequisite for effective wound healing, and a basic requirement of treating acute and chronic wounds that have become infected (Schultz et al, 2003; Wolcott, 2012; Strohal et al, 2013). The devitalized tissue is a physical barrier for wound re-epithelialization, and this dead tissue can also become a reservoir for bacterial growth and an increasing risk for infection, which adds further to the chronicity of wounds (Atkin and Ousey, 2016). Several clinical reports have highlighted the importance of wound debridement in the preparation of the wound bed for promoting the healing response (Kirshen et al, 2006; Marazzi et al, 2006; Ousey and McIntosh, 2010; Milne, 2015). HydroClean®mini is a dressing that enables autolytic debridement. In this study it was demonstrated to be able to provide rapid and effective debridement of wounds, that presented with significant levels of eschar/slough. Thus, the dressing enables removal of this barrier to healing, promoting good wound bed preparation and optimizing healing progression.

In this series of case studies, all wounds showed a decrease in wound size, indicating healing responses as a result of the treatment. This is particularly noteworthy since all wounds were in a static state, or, in some cases, worsening before starting treatment with HydroClean®mini.

It is noteworthy that it was observed that a number of patients who had their wounds treated with HydroClean®mini, exhibited skin hyper-hydration. The visual characteristics of skin hyper-hydration are similar to those seen in skin maceration, and may initially cause concern for the clinician (Rippon et al, 2016a). However, skin hyper-hydration has no detrimental effect on wound progression (as confirmed in this study) but is a consequence of good tissue hydration. Maceration, on the other hand, is detrimental to the healing response and indicates tissue damage due to inadequate ulcer exudate management by wound dressings (Rippon et al, 2016a and b).

The very best method of debridement for a patient is typically a balance between the debridement needs and the most appropriate (and available) debridement methods (Young, 2013). The debridement method chosen takes into account a number of factors, including safety, amount of devitalized tissue to be removed, availability of debriding equipment, time/speed needed to remove the devitalized tissue, and the skill/knowledge of the person undertaking the debridement (Young, 2011). If assessed as being an appropriate form of debridement, autolytic debridement offers a safer option than surgical debridement in many situations, and no specialist training is required (Young, 2013). Debridement via the application of a dressing that promotes autolytic debridement also offers the opportunity for self-care by the patient (e.g. because of ease of application), and could potentially reduce the length of time spent in hospital. Advanced wound dressings are designed to optimize wound healing quickly with minimal problems (e.g. pain experienced during dressing changes), and have been shown to be very effective in supporting the healing of acute and chronic wounds (Petruyte, 2008). There has been a rapid increase in the number of different wound dressings available for treatment of wounds, and this has led to confusion for wound care providers about which dressings to use and when to use it (van Rijswijk, 2006; Norris et al, 2012; Zenilman et al, 2013). Dressings such as HydroClean®mini can be used on any wound type and so will simplify wound care choice, whilst ensuring treatment efficacy.

In Hong Kong and Taiwan, the use of advanced wound dressings and the development of research in wound care is becoming established, and clinicians are increasingly embracing and further developing the tenets of wound bed preparation (Wong and Lee, 2008; Kwan et al, 2015; Choi et al, 2016; Lin et al, 2016; Tsai et al, 2019). The importance of surgical debridement has been highlighted in a variety of acute and chronic wounds (Cheung et al, 2009; Hsu et al, 2015; Chen et al, 2015). In addition, "new" methods for debridement (e.g. hydrogels to promote autolytic debridement) have been introduced, alongside traditional methods such as maggot therapy (Chan et al, 2007; Tse, 2016). The cases presented here show that effective debridement can be achieved using HydroClean®mini in a straightforward and easy to use manner.

## Conclusion

This case series demonstrates that HydroClean®mini was able to be used in a variety of different wound types, and could be applied and retained in anatomical positions that were awkward to treat. Debridement of devitalized tissue, an important part of any chronic wound treatment regimen, was shown as successful since all wounds treated with HydroClean®mini demonstrated rapid and efficient removal of devitalized tissue. This dressing was particularly useful in that it could be used by nurses and patients (for self-care) in a variety of hospital, community and home settings. WAS

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