Wound healing occurs in a dynamic continuous sequence. The process can be divided into the following steps: coagulation, inflammation, granulation, epithelialization, and maturation. It is dependent on oxygen delivery to tissue, pH of tissue, growth factors, and the supply of a local wound environment sustaining the cells involved in the repair mechanism. Maintaining a moist wound environment is one of the key factors in the wound healing process. A moist environment ensures rapid movement of epidermal cells, thereby enhancing epithelialization. Furthermore, the beneficial effect of a moist versus a dry wound environment can be attributed to the prevention of tissue dehydration and cell death, accelerated angiogenesis, increased breakdown of necrotic tissue and fibrin (debridement)—ie, pericapillary fibrin cuffs—and potentiating the interaction of growth factors with their target cells.

Treatment of Recalcitrant Wounds of Diverse Etiology With a New Hydroactive Gel

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Abstract: Our knowledge about wound care has progressed considerably in recent years. Nonetheless there is a continuing need for new topical hydroactive gels in this field. Flamigel® (Flen Pharma NV, Kontich, Belgium) has recently been used on a limited number of burn patients. The hydroactive colloid gel maintains the wound in an ideal moist environment. The polymer in the tube is present in two physical forms—active and inactive. In a dry wound, the active polymer will release part of its moisture to hydrate the wound and to create and maintain a moist wound environment (“hydrogel” effect). The inactive polymer remains inactive. In an exuding wound, the inactive polymer is activated by the wound exudate and starts absorbing wound exudate (“hydrocolloid” effect). The absorption ceases when the entire polymer is activated and saturated with exudate. The wound itself decides whether the hydroactive gel absorbs or hydrates; hydration in case of a dry wound, absorption in case of an exuding wound. As a result, the wound is kept in a moist environment, which optimizes wound-healing speed and reduces the likelihood of scarring. This study investigated the wound-healing capacities of the hydroactive gel in wounds that have failed to respond to other treatments.
Hydrocolloid dressings have been used on chronic ulcers, skin graft donor sites, and superficial second degree minor burn injuries. These dressings are occlusive and create an oxygen impermeable or low oxygen permeable moist environment and low pH in the wounds. Additionally, the dressings, which are occlusive by nature have been shown to improve wound healing by an increased rate of epithelialization, collagen synthesis, and keratinocyte proliferation.

Our knowledge about wound care has progressed considerably in recent years. Nonetheless there is a continuing need for new topical hydroactive gels in this field. Flamigel® (Flen Pharma NV, Kontich, Belgium) has recently been used on a limited number of burn patients and is a hydroactive colloid gel that maintains the wound in an ideal moist environment. The polymer in the tube is present in two physical forms, active and inactive. In a dry wound, the active polymer will release part of its moisture to hydrate the wound and create and maintain a moist wound environment (“hydrogel” effect). The inactive polymer remains inactive. In an exuding wound, the inactive polymer is activated by the wound exudate and starts absorbing wound exudate (“hydrocolloid” effect). The absorption ceases when the polymer is activated and saturated with exudate. The wound itself decides whether the hydroactive gel absorbs or hydrates; hydration in case of a dry wound, absorption in case of an exuding wound. As a result, the wound is maintained in an ideal moist wound environment, which optimizes wound-healing speed and reduces the likelihood of scarring.

This study was carried out in order to investigate the wound-healing capacities of the hydroactive gel in wounds that have failed to respond to other treatments.

**Case Reports**

**Case 1.**

**Presentation.** An 82-year-old man developed a wound infection after a colon carcinoma operation. The wound opened again and had to heal by secondary intention (Figure 1).

**Wound treatment history.** The postoperative wound presented as a red/yellowish gap filled with a large amount of slough. The wound was infected with Pseudomonas aeruginosa and treatment was started with a gentamicin-containing collagen sponge. After 2 weeks of treatment, the wound still presented with *P. aeruginosa* infection. After 1 month, *Enterococcus ssp* were also identified and it was decided to cease treatment with the gentamicin-containing collagen sponge.

**Treatment.** The wound was thoroughly cleaned with an isotonic buffered wound cleanser after which the wound was covered with a thick layer of the hydroactive gel (5 mm). The wound was covered with a gauze compress superimposed with a PU film. Changes were made daily. No infections were recorded during treatment and over a period of 4 weeks the wound showed granulation tissue formation accompanied by re-epithelialization.

**Outcome.** As handling was relatively simple (10 minutes including cleansing, application of gel, and covering...
with compress and film) the patient could be treated at home. The wound had sufficiently healed after 30 days of treatment and the patient was able to go home.

**Case 2.**

**Presentation.** An 87-year-old man with arterial and venous insufficiency and atherosclerosis presented with serious decubitus wounds on both heels as a complication after immobilization due a total hip replacement (Figure 2).

His medical history consisted of a deep second-degree burn of his left-hand palm, venous circulation disorders, and a pacemaker. Citro-flavonoides (2/day 500 mg) and canrenone (1/day 100 mg) was given for circulation disorders and venous edema.

**Wound treatment history.** After the patient was discharged from hospital, the wounds were fully debrided at home and treated with povidone-iodine ointment and sterile gauze. The patient developed eczematous reactions to povidone-iodine ointment around the wound edges and it was decided to pursue a treatment of wet compresses impregnated with potassium permanganate covered with an absorbing non-adherent dressing. Although the wounds showed no signs of infection, there was little progression in wound evolution. In addition the patient developed an allergic reaction to the absorbing non-adherent dressing. Treatment with potassium permanganate was continued but this time silver sulfadiazine (SSD) cream was used as the dressing. The patient developed an allergic reaction to silver and treatment with the SSD cream was discontinued. The wound was irrigated with Dakin's solution and a foam dressing. As the wound continued to exude, it was decided to use potassium permanganate solution and a methylcellulose amorphous hydrogel. The wound progressed slowly and after a month the patient showed signs of irritation to the methylcellulose amorphous hydrogel.

**Treatment.** It was then decided to cleanse the wounds with an isotonic buffered solution and use the hydroactive gel combined with gauze as the secondary dressing.

**Outcome.** The wounds evolved quickly and after 6 weeks the right heel was completely healed.

**Case 3.**

**Presentation.** A 61-year-old woman who had undergone a hysterectomy and required further daily radiotherapy treatment for 1 month. After 22 days, she developed signs of first- and second-degree burns in the radiated area (Figure 3A).

**Wound treatment history.** During the first 2 days the burn lesions were treated with SSD cream. The wound showed severe discoloration and, additionally, the patient experienced great pain during removal of the cream. It was therefore decided to cease treatment with the SSD cream.

**Treatment.** The wound was thoroughly cleansed with an isotonic buffered wound cleanser and covered with a thick layer of the hydroactive gel (5 mm). The gel
was allowed to penetrate the burned skin and was not covered with secondary dressings. Renewal of the dressing was performed up to 5 times daily and specifically following defecation. Radiation was continued daily. The hydrogel did not interfere with radiotherapy and the patient appreciated the comfort of the hydroactive gel.

**Outcome.** The small wounds quickly healed and redness, irritation, and scaling disappeared. The patient appreciated the rapid and simple dressing changes. The wounds showed clear signs of healing within 6 days. Figure 3B shows the burn after 6 days of treatment.

**Case 4.**

**Presentation.** A 75-year-old woman recovering from a hip fracture showed a decubitus on the sacrum following hospital discharge. The wound presented as yellow/red, 8 cm in diameter and 1.5 cm deep, and was infected with *P aeruginosa* (Figure 4).

**Wound treatment history.** At first the wound was treated with a tobramycin-containing ointment, which did not result in progression.

**Treatment.** The wound was cleaned with an isotonic buffered wound cleanser, then with an isotonic 0.9%
sodium chloride solution and dabbed dry. It was covered with a thick layer of the hydroactive gel (5 mm) and a sterile 5 cm x 5 cm sterile compress was used to keep the gel in place. An absorbent, non-adherent dressing and polyethylene (PE) film were used as secondary dressing. Treatment was carried out once daily. After 1 week of treatment the wound had become dark red, indicating a sufficient blood supply, and granulation tissue had formed. The amount of exudate had decreased. After 17 days of treatment the wound had become smaller and the wound edges were less swollen. Six weeks later the wound began to re-epithelialize and contract.

**Outcome.** The wound continued to heal and became smaller and more superficial while the wound edges became less swollen. After 10 weeks the wound was almost completely healed. The time needed for each care had decreased from more than 10 minutes to 4–5 minutes. After 3.5 months the wound presented as a 1.5-cm wide cavity. At that time the patient was discharged and returned home.

**Discussion**

The purpose of this study was to verify whether a new hydroactive gel could be used for wounds that failed to react to other treatments. The product is delivered as a specific formulation that contains a low concentration of active polymer, a higher concentration of inactive polymer, and a high concentration of water. Upon interaction with the wound bed, the inactive polymer becomes activated; the gel adjusts its absorbent and hydric properties to the local conditions of the wound (dry or exuding wounds) and creates a moist environment conducive to wound healing. The moist environment enhances granulation, epithelialization, and ultimately healing. This study confirms previous clinical observations that a dressing that creates a moist environment is also capable of inducing faster epithelialization, is less painful, and is more comfortable for the patient than less moisture-retentive dressings. The hydroactive gel was also found to be easy to apply and remove.

**Conclusion**

This hydroactive gel can be used as an alternative for the treatment of recalcitrant wounds since it promotes early onset of granulation and epithelialization. The authors hypothesize that the accelerated wound healing can be explained by the action of the product on the moisture balance in the wound. The inactive polymer in the gel, which is activated when in contact with wound exudate, will hydrate dry wounds and absorb excess exudate from exuding wounds, and thereby creates a moist environment that promotes healing. As a consequence, use of the gel would result in a satisfactory aesthetic outcome. Several groups have reported reduced scarring and wounds that heal rapidly as a result of the ideal moisture balance provided by dressings. In addition to regulating the moisture balance, the high water content in the hydrogel combined with a protective semipermeable polymer layer that is built on the wound creates a cooling effect—this probably explains the greater comfort the patient in Case 3 experienced.

Patients left the hospital before complete wound closure, which is the standard procedure. Larger studies monitoring wound healing until complete wound closure are warranted in order to confirm the observations made in this small number of cases.

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**References**


