Avance® Negative Pressure Wound Therapy – Case Study Evaluation

'NPWT has also gained rapid acceptance by physicians and plastic surgeons in the management of acute and hard-to-heal wounds'

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The Avance® Negative Pressure Wound Therapy (NPWT) system (Mölnlycke Health Care) is easy to use, lightweight, and portable. The system promotes patient mobility and is minimally obtrusive. In this series of case studies, the author looks at the use of the Avance NPWT system, using either a foam or gauze dressing as a therapeutic option, in the treatment of a range of acute and hard-to-heal wounds.

In general, the application of the Avance system was straightforward, being described variously as 'quick', 'convenient' and 'time-saving'. It was associated with the rapid control of infection, substantially reduced exudate levels, the control of oedema, the stimulation of granulation tissue formation, decreased pain scores (as reported by the patients receiving the treatment), and the preservation of the periwound skin.

BACKGROUND

NPWT is widely used to manage wounds and accelerate healing, and has also gained rapid acceptance by physicians and plastic surgeons in the management of acute and hard-to-heal wounds (Moues et al, 2005). The delivery of NPWT to the wound takes two forms, each of which was developed independently, with the major difference between them being the type of dressing used — foam (Argenta and Morykwas, 1997) or gauze (Chariker et al, 1989).

Most existing clinical evidence for the usefulness of NPWT is derived from the use of foam at -125mmHg (Eginton et al, 2003; Armstrong and Lavery, 2005; Braakenburg et al, 2006). However, the use of alternative dressing interfaces, namely gauze, has also been described. This technique uses a moistened gauze wound interface with a -80mmHg pressure setting (Campbell, 2006;Campbell et al, 2008;Chariker et al, 2009).

Additionally, an atraumatic soft silicone wound contact layer (Mepitel® [Mölnlycke Health Care]) can be applied between the wound bed and the NPWT to minimise pain during dressing change and prevent in-growth of tissue into the dressing. This subsequently minimises trauma to wounds at dressing removal (Banwell, 1999; Terrazas, 2006). The Mepitel interpositional dressing can also be used to protect exposed organs from the direct positioning of NPWT. Mepitel consists of a porous, transparent, flexible polyamide net with open mesh structure coated on both sides with Safetac® (Gotschall et al, 1998; O'Donovan, 1999). Exudate can pass through this interpositional layer into a secondary dressing. Mepitel® One (Mölnlycke Health Care), which is coated on just the wound contact surface with Safetec to facilitate ease of handling and application, is also available.

Mepitel has been used successfully with NPWT, as borne out in a number of case studies (Blakely and Weir, 2007; Dunbar et al, 2005; Poulakidas and Kowal-Vern, 2008). In addition, a number of randomised controlled trials and one observational study have shown Mepitel to be associated with significantly less wound bed adherence (Dahlstrøm, 1995; O'Donovan, 1999), less bleeding (Dahlstrøm, 1995), less pain and discomfort, (Dahlstrøm, 1995; Gotschall et al, 1998; Meuleneire, 2002), less time required for dressing removal (Dahlstrøm, 1995; Platt et al, 1996), significantly lower stress scores (O'Donovan, 1999), significantly faster healing rates (Bugmann et al, 1998; Gotschall et al, 1998; Meuleneire, 2002), and a reduced requirement for numbers of dressings used (Bugmann et al, 1998), compared with the use of traditional dressings.

The NPWT device applies a localised vacuum to draw the edges of the wound

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together, while providing a moist environment conducive to rapid wound healing. The clinical benefits associated with the use of NPWT are summarised in *Figure 1*.

Avance is a new NPWT system that uses a lightweight and portable pump, allowing it to be employed in both acute and home-care settings. It is indicated for use in the management of both acute and hard-to-heal wounds with the objectives of:

- Promoting granulation tissue formation
- Promoting perfusion
- Maintaining a closed wound environment
- Removing oedema
- Removing exudate and minimising bacterial colonisation
- Assisting with wound contraction and closure.

In the following series of case studies, the outcomes of treating a variety of wounds with the Avance NPWT system are presented.

METHOD

In a series of six case studies, the Avance NPWT system was used to treat patients with the following conditions:

- Arterial occlusion
- Traumatic wound on left ankle
- Chronic wound caused by crush injury (multiple fracture of calcaneus)
- Deep wound with high level of exudate
- Purulent and malodourous abscess
- Problematic leg ulcer due to chronic venous insufficiency.

- **Removal of exudate** (Stannard et al, 2006; Ford-Dunn, 2006; Ballard and Baxter, 2001)
- **Increased local blood flow and reduced oedema** (Argenta et al, 1997; Chen et al, 2005)
- **Assistance with wound contraction** (Mullner et al, 1997; Joseph et al, 2000; Campbell et al, 2008)
- **Stimulation of granulation tissue** (Morykwas et al, 2001; Morykwas et al, 1997; Argenta and Morykwas, 1997)
- **Protection from outside contaminants**
- **Increased vascular perfusion** (Chen et al, 2005; Kamolz et al, 2004; Timmers et al, 2005)
- **Decreased wound bioburden** (Giovannini et al, 2001; Moues et al, 2004).

Figure 1: Clinical benefits associated with the use of NPWT.

CASE STUDY ONE

This centred on a 68-year-old male with arterial occlusion. His past medical history included vascular surgery involving bypass procedure performed to the right groin. Two weeks after the operation, wound dehiscence occurred. The highly exuding wound had been treated with an alginate covered by a film dressing.

Wound treatment

The goal of this wound treatment protocol using the Avance NPWT system was to avoid infection at the vascular prosthesis and to stimulate the granulation process. The prosthesis had to be protected quickly.

The Avance NPWT system, using the Avance green foam dressing, was commenced using a negative pressure level set at –140 mmHg. The surrounding skin was protected with a hydrocolloid dressing and dressing changes were performed every three days.

Outcomes

Day 1

No clinical signs of infection were observed on the first day of treatment (*Figure 2a*). Moderate levels of exudate were noted with irritation of the surrounding skin. On the visual analogue scale (VAS) for pain severity (1–10), at dressing removal, the patient indicated a score of three.

Day 4

Granulation tissue was observed over the entire wound bed with no signs of infection (*Figure 2b*). The exudate level was moderate with healthy skin surrounding the wound. The VAS pain score was four at the time of dressing removal.

Day 7

Good wound contraction was noted with granulation tissue forming on the wound surface (*Figure 2c*). There were no signs of inflammation or oedema and levels of wound exudate were low. The skin surrounding the wound was in good condition. Patient pain (VAS)

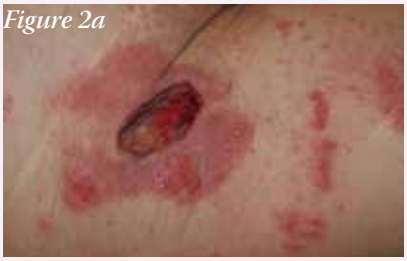
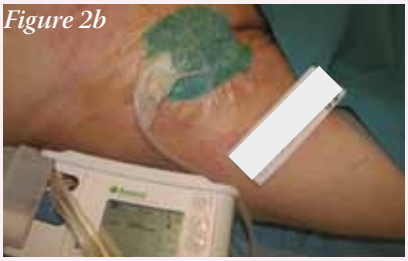


Figure 2a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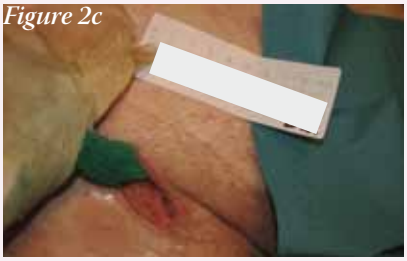
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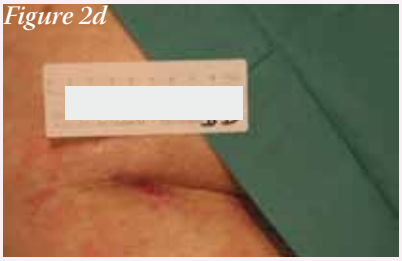
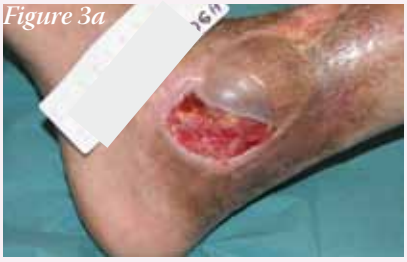


Figure 2d

Figures 2a-2d (above): Case study one, treatment days: 1(a), 4(b), 7(c) and 21(d).

Figures 3a-3d (below): Case study two, treatment days: 1(a), 3(b), 6(c) and 9(d).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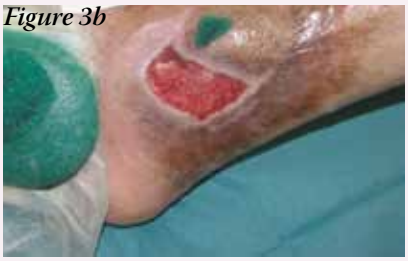
Figure 3b


Figure 3c

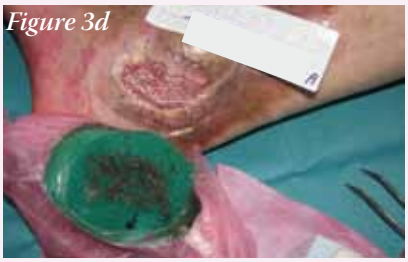
Figure 3d

rating was one during treatment and four at the moment of removing the foam dressing material.

Day 21

The wound had almost closed with no cavity visible (*Figure 2d*). There were no signs of infection and only low level exudation. The skin surrounding the wound was normal and the patient recorded a pain severity (VAS) score of two.

Summary

Avance NPWT system was found to be easy to use and successfully protected the prosthesis against infection and contamination. It was considered an advantageous treatment approach in terms of the care time required to treat the patient.

CASE STUDY TWO

The patient was a 51-year-old male who had had a traumatic wound on the left ankle of five years' duration. Prosthesis material had been exposed in the wound bed and supplementary factors contributing to the hard-to-heal nature of the wound were considered to be arterial insufficiency and smoking. A muscle flap had been constructed to cover exposed bone and prosthesis

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‘The goal was to protect the underlying bone and prosthesis material with the objective of stimulating granulation tissue and preparing the tissue for skin grafting’

material, but part of the flap had become necrotic.

Although the wound had been treated with several dressings, granulation tissue could not fill the cavity. In addition, the wound was critically colonised with *Serratia marcescens*.

Objectives and wound treatment

The goal of this wound treatment protocol using the Avance NPWT system was to protect the underlying bone and prosthesis material with the objective of stimulating granulation tissue and preparing the tissue for skin grafting.

Avance NPWT, using green foam dressing, was commenced. Following placement of the skin graft, the application of NPWT was continued in order to improve the chances of skin survival.

Outcomes

Day 1

Serratia marcescens colonisation continued to be evident in the wound, but there was no inflammation (*Figure 3a*). Exudate levels were moderate and there were no problems with the surrounding skin.

The pain severity (according to a VAS score) was four.

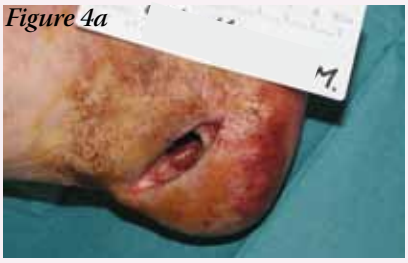


Figure 4a


Figure 4b

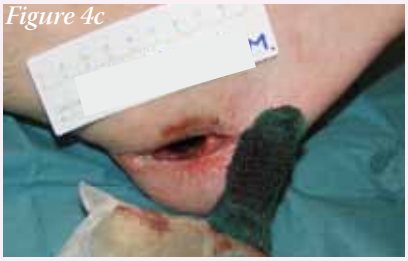


Figure 4c

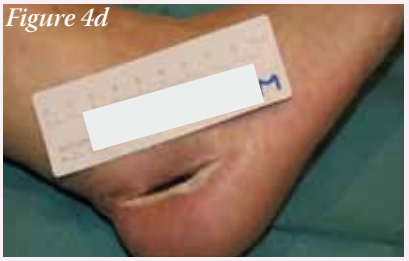


Figure 4d

Figures 4a-4d (above): Case study three, treatment days: 1(a and b), 4(c) and 34(d).

Figures 5a-5d (below): Case study four, treatment days: 1(a), 4(b),13(c) and 19(d).

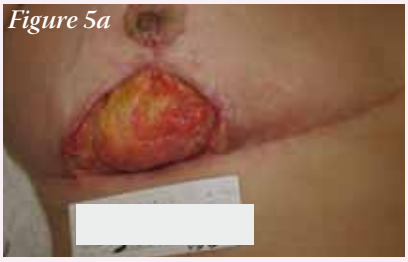
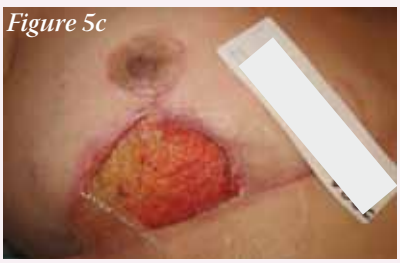


Figure 5a


Figure 5b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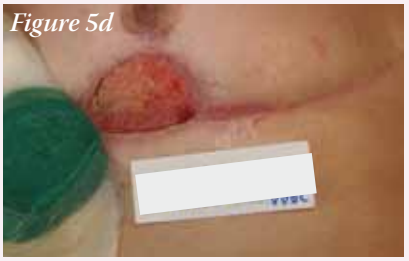
Figure 5d

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Day 3
There were no signs of infection and exudate levels were low (*Figure 3b*). An interpositional film dressing protected the wound from direct contact with the green foam dressing. At the moment of foam removal a pain severity (VAS) score of four was reported.

Day 6
On the day of the operation the wound was prepared with a curette. There were no signs of infection, and exudate levels were low (*Figure 3c*). There were no problems with the skin surrounding the wound. Since anaesthesia was used pain severity (VAS) score was zero.

Day 9
Good in-growth of the skin graft was noted and there were no signs of infection (*Figure 3d*). Wound exudate levels were low and there were no problems with the surrounding skin. No pain was reported.

Summary
Avance NPWT system was found to prepare the wound bed for grafting well. The wound surface was considered perfect for split-thickness skin graft take.

CASE STUDY THREE
Case study three centred on a 68-year-old female who had suffered an accident 15 years previously, resulting in a crush injury causing a multiple fracture of the calcaneus. The patient was a regular smoker. Due to the chronic wound, the patient also had limited mobility. The patient had undergone several operations. A fistula with bone contact produced purulent wound exudate and *Streptococcus agalactiae* and *Staphylococcus aureus* had been found in the wound cultures.

Nuclear magnetic resonance (NMR) showed severe bone destruction due to infection. A rigorous debridement of bone and weak tissues was necessary to remove as much of the damaged tissue as possible. Postoperatively a very deep wound with bone contact on the wound bed was observed.

Objectives and wound treatment
The goal of this wound treatment protocol was to use the Avance NPWT system to remove wound exudate and close the deep wound cavity in the fastest possible time. NPWT was commenced 24 hours after debridement using a negative pressure setting of -125 mmHg.

Outcomes
Day 1
Bleeding in the wound bed was evident (*Figures 4a and 4b*). There was no odour or other signs of infection. Exudate levels were low and the skin surrounding the wound was normal. Before commencement of wound care a pain severity (VAS) score of three was recorded. The wound cavity was very deep. The wound area was protected with a film dressing. The VAS score during wound care was six.

Day 4
After only three days, wound contraction was already evident (*Figure 4c).* There were no signs of infection, exudate levels were moderate and there were no problems with the surrounding skin. During removal of the foam dressing a pain severity (VAS) score of five was reported.

Day 34
Granulation tissue was seen to form rapidly, exudate levels were low, and the wound edges were normal (*Figure 4d).* There were no signs of infection. During wound care a pain severity (VAS) score of four was recorded.

Summary
The Avance NPWT system was found to achieve very good results over the course of one month's treatment. After this time the wound became so narrow that further treatment with the Avance system was no longer necessary. The wound was subsequently treated with Melgisorb Ag® (Mölnlycke Health Care).

CASE STUDY FOUR
The patient was a 54-year-old female who had undergone a breast reduction operation. Underlying problems for this patient included rheumatism and arthritis. One week postoperatively, the wound became necrotic. A week after this, the necrotic tissue was removed, but the resulting large and deep wound produced a high level of viscous exudate.

Objectives and wound treatment
The goal of this wound treatment

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Figure 6a

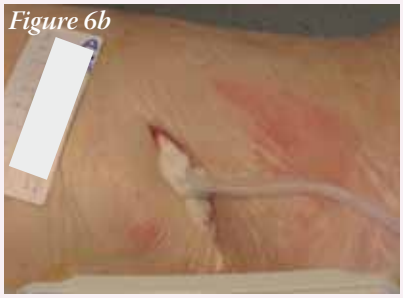


Figure 6b

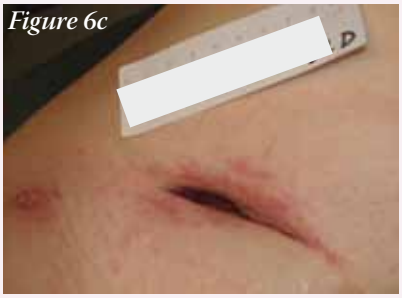


Figure 6c

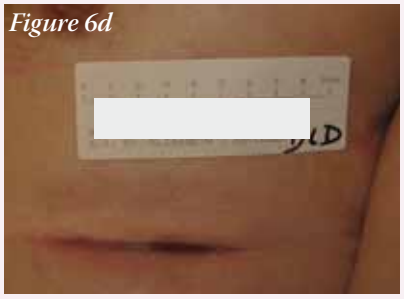


Figure 6d

Figure 6: Case study five, treatment days: 1(a and b), 8(c) and 44(d).

protocol was to use the Avance NPWT system to absorb the high levels of exudate produced, decrease wound oedema, and stimulate the granulation process. Mepitel One was used as an interface layer to protect the frail new granulation tissue, consequently a high negative pressure setting of -140mmHg was considered necessary.

Outcomes

Day 1

There were no signs of necrotic tissue (*Figure 5a*). The wound surface was partially fibrinous. The wound bled easily during wound care, but there were no signs of infection, although the wound was highly exuding. The skin surrounding the wound was normal. The pain severity (VAS) score was recorded as four.

Day 4

Granulation tissue was starting to develop at the wound edges (*Figure 5b*). Signs of oedema were no longer evident. More flat edges were evident. The pain severity (VAS) score was three.

Day 13

The surface of the wound appeared healthy. There were no signs of infection and exudate levels were moderate (*Figure 5c*). There were no longer any undermining wound edges. A pain severity (VAS) score of two was recorded.

Day 19

The wound appeared superficial. There was no evidence of bacterial involvement; levels of wound exudate were low (*Figure 5d*). Obvious epithelialisation at the wound edges was evident. The pain severity (VAS) score was recorded as two.

Summary

Avance NPWT system was found to be very effective in decreasing wound oedema. The application of the Avance system in combination with Mepitel One was found to be straightforward.

CASE STUDY FIVE

The patient was a 58-year-old male, who due to a pulmonary infection, had developed an abscess that was subsequently drained surgically. The exudate was very purulent and malodorous. Dressings had to be changed three times each day.

Objectives and wound treatment

The goal of this wound treatment protocol was to use the Avance NPWT system to make the patient more comfortable while at the same time quantifying the level of exudate being produced. In this case, a gauze (rather than a foam) system was used with the Avance pump. For this reason, and also due to the location of the abscess the negative pressure was set at -60mmHg.

Outcomes

Day 1

The wound showed clear signs of infection, with high levels of viscous exudate (*Figures 6a and 6b*). The skin surrounding the wound was macerated. Due to the high level of wound infection, meticulous cleansing of the wound was required. Before the commencement of wound care the pain severity (VAS) score was four — at the time of wound care the score was six.

Day 8

Although the level of wound exudate had decreased, it remained purulent (*Figure 6c*). Minor skin irritation was evident at the wound edges. At dressing change, the pain severity (VAS) score was five.

Day 44

There were no signs of infection or wound exudate (*Figure 6d*). Epithelialisation was observed at the wound edges. A pain severity (VAS) score of one was recorded.

Summary
Avance NPWT system was found to be an ideal treatment option for the wound. Over a very short time period, good management of the wound was achieved, especially with respect to infection and exudate.

CASE STUDY SIX

This case centred on an obese 65-year-old man, who for the past 20 years, had chronic venous insufficiency which resulted in recurrent, problematic leg ulcers on both ankles. The ulcers had been treated with highly absorbent dressings in combination with short-stretch bandages. As a result of the patient not complying with treatment, he developed extreme oedema which led to the formation of blisters and resulted in the exacerbation of the leg ulcers.

Objectives and wound treatment

The goal of this wound treatment protocol was to decrease the level of oedema, clean the wound bed, and absorb excessive levels of exudate. Mepitel One was used as an interface dressing positioned between the painful skin and the Avance NPWT foam. Dressing changes were performed twice a week.

Outcomes

Day 1

The wound surface appeared fibrinous. The wound was malodourous and painful (pain severity (VAS) score seven). Levels of wound exudate had decreased but its continued presence had resulted in increased wound irritation (*Figures 7a and 7b*). The Avance NPWT system effectively cleansed the wound with negative pressure restoring bacterial balance and efficiently absorbing wound exudate.

Day 6

The wound was no longer infected and the levels of wound exudate and the oedema were well-controlled (*Figure 7c*). The periwound skin condition had improved. The pain severity (VAS) score was four.

Day 94

Three weeks after the last application of Avance NPWT, a well controlled bacterial balance had been achieved (*Figure 7d*). Wound exudate was well managed with healthy skin surrounding the wound. The pain severity (VAS) score was two.

Summary
Avance NPWT system was found to exert its beneficial effects rapidly over the course of five days. Following this, the extent of wound oedema and level of exudate were proficiently managed. NPWT was discontinued as exudate level and oedema decreased and the treatment protocol was changed to incorporate local dressings with short-stretch compressive bandages.

CONCLUSION

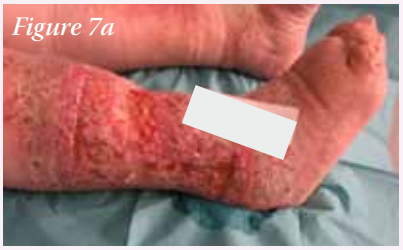
The Avance NPWT system has been designed to provide safe and effective treatment of wounds in a variety of healthcare settings and for a variety of clinical presentations. The system uses a lightweight (less than 1kg) portable pump for which a unique docking station has been designed to promote patient mobility during therapy.

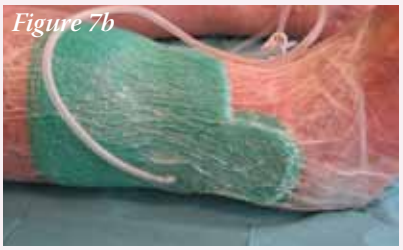
Furthermore, the Avance system can be utilised with either a foam or gauze dressing allowing treatment flexibility at the discretion of the treating physician. A published pre-clinical study has shown that the foam and gauze dressings provided with the Avance NPWT system are functionally equivalent to other commercially available dressings for use with NPWT (Malmsjo and Ingemansson, 2010).

Additionally, the green colour of the Avance Foam has been reported as being advantageous due to its high visibility, which facilitates easy monitoring of exudate and detection of any bleeding (Stansby et al, 2010). The limits within which the pressure settings are used vary between the gauze and foam dressing applications — the suggested settings for the gauze dressing kit lie between the ranges of -60 to -80mmHg and -70 to -120mmHg for the foam kit.

In the case studies presented in this paper, the results following the use of the Avance NPWT system were encouraging with respect to its ease of use and convenience, its effectiveness at maintaining a manageable wound bioburden, its ability to control wound exudate levels and oedema, and its potential to promote the formation of granulation tissue.

In addition, a reduction in pain severity over treatment time indicates increased patient comfort. WUK





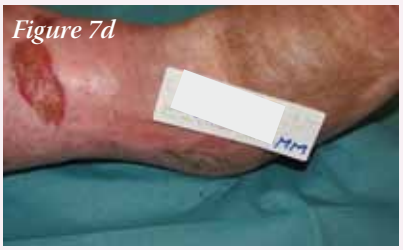


Figure 7: Case study six, treatment days: 1(a and b), 6(c), and 94(d).