The treatment of problematic wounds with TenderWet – 10 years in clinical practice
The treatment of problematic wounds with TenderWet – tried and tested over many years in clinical practice

Over the last few years, numerous patients suffering from poorly-healing problematic wounds have been successfully treated with the TenderWet wound dressing pad. But it is not only patients with chronic wounds such as arterial or venous ulcers, decubital ulcers and diabetic foot syndrome who benefit from the wound dressing pad. The application of TenderWet has also proved valuable for wound complications (infections, haematomas) following surgical procedure, for burn wounds and for problematic wounds in which the wound base needs to be conditioned for a skin graft. Of the large number of wounds treated with TenderWet throughout the world, successful treatment processes in over 110 patients have been documented in medical journals in the form of clinical studies and case reports of which the most interesting ones are set out below.

In the western industrial nations, some 2% of the population suffer from chronic wounds. In the USA alone, 6.5 million patients are treated annually for chronic wounds, and for Germany the figure is 2.5 million. And as a consequence of rising life expectancies, the number of patients at risk is steadily rising. The incidence in people over 80 is between 4% and 5%. Approximately 60-80% of patients with a chronic wound have leg ulcers (ulcus cruris venosum), need, because of their chronic venous insufficiency, also to have a compression therapy applied as the basic treatment. For an arterial ulcer, in addition to the wound treatment, revascularising measures are recommended together, possibly, with rheologic agents to treat the peripheral occlusive arterial disease.

Stage-adapted use of hydroactive wound dressings

The basis of a modern wound treatment is the stage-adapted use of hydroactive wound dressings. Moist wound treatment promotes the cleansing of the wound, the proliferation and synthesis of structural proteins and coordination of the cell processes during wound healing (chemotaxis, mitotic activity, angiogenesis, keratinocyte migration, etc.). It is the aim of a stage-adapted wound treatment to accelerate the transition from the existing wound-healing stage to the following wound-healing stage. In chronic wounds, this transition is disrupted. They persist in the inflammatory stage, epithelization usually remains absent and only little granulation tissue has formed on the wound base.

Within the setting of the stage-adapted use of modern wound dressings, the TenderWet and TenderWet 24 wound dressing pads are indicated when the wound needs to be actively cleansed and the wound base conditioned (Fig. 1). This affects, above all, poorly-healing wounds with heavy exudate, high bacterial load, and chronic wounds of various aetiology, such as diabetic gangrene, decubital ulcers and venous leg ulcers. Before a split-skin graft, also, TenderWet and TenderWet 24 perform a valuable service through their cleansing and conditioning effects on the wound bed enhancing the chances that the graft will grow successfully.

The absorbing and rinsing effect of TenderWet

TenderWet and TenderWet 24 are multilayer wound dressings, in the shape of a pad or cushion, with an absorbent core containing superabsorbent polycrylulate. The super absorber, which is chemically inert and
free from active agents, is activated with Ringer’s solution before application of the wound dressing pad. The TenderWet 24 wound dressing has a similar structure, but with a moistureproof layer to prevent strike-through of the dressing and can remain on the wound for up to 24 hours. When should each wound dressing pad be used? TenderWet 24 is indicated for use with superficial wounds, whilst TenderWet is suited to pack deep wounds. TenderWet and TenderWet 24 (as a secondary dressing) can also be used in combination, though TenderWet only, has to be changed twice daily. A 24-hour dressing change interval is sufficient when TenderWet is used to pack deep wounds. In such cases, the danger of the wound drying out is slight, so that the wound dressing can be changed less often.

When TenderWet is activated and placed to the wound, the wound dressing pad delivers the Ringer’s solution to the wound. (Fig. 2). In this process, necrotic tissue and coatings are softened and detached. At the same time, the wound dressing pad absorbs bacteria-laden wound exudate into its absorbent core and binds it there. This exchange - (Ringer’s solution delivered and proteins taken up) - functions because the super absorber of the wound dressing pad has a higher affinity for the protein in wound exudate than for the salts in Ringer’s solution. That way TenderWet rinses and cleanses the wound. As the wound is being cleansed of necrotic tissue, detritus and coatings, the conditions are provided for cellular migration, angiogenesis and the formation of granulation tissue. The aim of using TenderWet is to cleanse the wound so that granulation tissue can form.

Both the absorbing and rinsing effect and the absorption of bacteria-laden wound exudate have been demonstrated in laboratory investigations. As the in vitro experiments show, TenderWet 24 continuously deliver Ringer’s solution to its surroundings over the application period (Fig. 3a). At the same time the wound dressing pad is capable of absorbing proteins from the wound model and binding them in the super absorber (Fig. 3b). The absorption and retention of bacteria-laden wound exudate are also observable. Micro-organisms which have formed a lawn on agar plates (Fig. 4), or have multiplied in a suspension (Fig. 5) were absorbed by TenderWet and reduced in number. As electronmicrographs have been able to show, the bacteria adhere to the surface of the super absorber (Fig. 6).

The wound dressing pad has been successfully used on countless patients over the last few years. Of these, some 110 cases have been documented in medical journals with the publication of case reports and clinical trials, of which the most interesting are set out below. The publications make clear how TenderWet promotes the wound healing process with its absorbing and rinsing effect and how broad the application possibilities are in clinical practice.
Decubital ulcers

Many patients with decubital ulcers – like most patients with chronic wounds – have a long history of the condition. Their chronic wounds often persist for months, and sometimes for years, showing no healing tendency. The case reports of patients with decubital ulcers published in the literature show that consistent treatment with hydroactive wound dressings – and above all with TenderWet – significantly improve treatment success with these problematic wounds.

In the case of a 75-year old multimorbid patient, following a femur fracture, a 10 x 10 cm sacral decubital ulcer formed. Over a 5-month period the ulcer was treated using TenderWet. Under this treatment, the wound was rapidly cleansed of necrotic tissue and coatings, and florid granulation tissue was formed. Once the defect size had been reduced to 1.5 x 1 cm, treatment with TenderWet was ended and another treatment begun (Fig. 7). Similarly successful was the treatment of a 72-year old patient who, apart from a decubital ulcer in the sacral region, also had a marked necrosis on the left heel and a decubital ulcer on the left hip. The decubital ulcer in the sacral region was packed with the calcium alginate dressing Sorbalgon and covered over with TenderWet. After six weeks, all the necrotic fibrin coatings were detached and the wound showed healthy granulation tissue. After a little more than three months, the wound was flat, showed good granulation, and was epithelized starting from the margin. A further month later, the decubital ulcer had healed.

The necrosis on the left heel was also treated with Sorbalgon and TenderWet. Since the wound had shrunk significantly after three months, it was then only treated with TenderWet. Five months after the start of application of TenderWet and Sorbalgon, the decubitus on the heel had healed completely. The decubitus ulcer on the hip was also treated with TenderWet. Although the necrotic tissue was detached, wound healing stagnated. Once a persisting source of pressure had been eliminated, the wound was treated with Sorbalgon and TenderWet, under which the decubital ulcer slowly healed. After a total of ten months’ treatment, this decubital ulcer had also healed (Fig. 8-10).

Diabetic foot syndrome

Patients who suffer from diabetic foot syndrome often suffer for months or even years with chronic wounds. In many cases during the course of treatment, toes or part of the foot have to be amputated. The case report of a 50-year old patient suffering from diabetes mellitus shows impressively how the application of TenderWet can prevent an amputation. The patient was hospitalised due to an infected diabetic foot ulcer on the right big toe (with soft tissue infection and osteolytic changes). The amputation that would usually have taken place was refused by the patient, so the ulcer was opened and debrided surgically. Following this, a TenderWet wound dressing was applied. Signifi-
Decubital ulcer in the sacral region
7a-c 75-year old patient. Documentations of a course of treatment with TenderWet from mid-November 1996 to April 1997, residual defect approx. 1.5 x 1 cm.

8a/b Admission findings on 8/8/01, immediate start of the treatment: Pressure relief with the aid of an antidecubitus mattress, also 2-hour repositioning of the patient; wound treatment locally with calcium alginate Sorbalgon dressings, which could be readily packed into wound (Fig. 8b of 23/8), and additional covering with TenderWet. Dressing changes have been made once a day.

8c/d Show the further healing process (24/9 and 2/10) proceeded well without setbacks. From 15/11, the well granulated and epithelized wound was covered only with a PU film which, depending on its level of soiling, was changed every 2 or 3 days.

8e Wound condition on 22/11.

8f On 17/12/01, the decubital ulcer was declared to be healed.

Decubital ulcer on the left heel
9a Admission findings on 8/8/01, start of local wound treatment with TenderWet; the heel was positioned free to relieve pressure on it; careful surgical necrosis removal on 28/8 and 19/9.

9b Condition of the wound on 24/9.

9c/d During the necrosis removal, a deeper-going tissue pocket was revealed which was packed with Sorbalgon from 2/10. The wound was also further treated with TenderWet.

9e As healing increased, only TenderWet was used. Condition of the wound on 17/12.

9f On 11/1/02, the heel decubital ulcer was declared to be healed.

Decubital ulcer on the left hip
10a Admission findings on 8/8/01, immediate start of the treatment: Pressure relief with the aid of an antidecubitus mattress, local wound treatment with TenderWet.

10b-d As expected, necrosis detachment took place. However, this stagnated as time passed, the ulcer grew and new necrotic tissue formed. The cause of this relapse was pressure from the mattress.

10e After removal of the pressure and consistent continuation of the Sorbalgon/TenderWet treatment, healing slowly progressed. Condition of the wound on 27/2/02.

10f On 15/6/02, the decubital ulcer was declared to be healed.
50-year old patient suffering from diabetes mellitus: diabetic ulcer on the right big toe with soft tissue infection and osteolytic changes on distal phalanx of toe. 

11a Findings: ulcer before incision on 9/9/99.
11b Wound situation after incision with drainage inserted.
11c Wound situation after repeated surgical debridement, necrotic residues and coatings, further treatment with TenderWet.
11d Ulcer packed with TenderWet, wound cleanses rapidly, start of formation of granulation. Due to the advance in healing, the patient was discharged (29/10).
11e Wound situation on 11/11: The wound was almost apposed and the wound opening was very narrow. Treatment was therefore changed to the hydrogel AquaClear. The wound was completely healed after four months and the patient was able to put full loading on it without difficulty (Fig. 11).

11f Wound situation on 9/12: The wound margins are almost apposed.
11g Wound treatment is changed to hydrogel Hydrosorb.
11h Final photograph on 13/1/00: The wound is completely healed and stable under load.

Diabetic foot syndrome

Leg ulcer (ulcera cruris) of various genesis

The fact that TenderWet promotes the wound healing process of a wound even in patients with leg ulcers (ulcera cruris) is attested to by the numerous case reports published in the literature and two observational studies with a total of 51 patients. The cleansing and conditioning effects of the wound dressing pad occurred regardless of the aetiology of the ulcers. Those who have profited from this are, above all, the patients on whom a variety of treatment methods have been tried out over many months without success, before the application of TenderWet was able to close the wound. An example of this is the case report of a 66-year old patient with a venous ulcer which had been treated for ten months without success. Following a change-over to TenderWet, the exudation reduced after a few days, the wound began to cleanse itself and florid granulation tissue slowly formed on the wound base. Over the subsequent weeks, the wound decreased in size until, after a total of three months, the ulcer was completely healed (Fig. 12).

An 87-year old woman had suffered significantly longer from her ulcer in the gaiter area. The chronic wound had persisted for over 35 years. The chronic venous insufficiency of the multimorbid woman could, however, not be treated due to her poor general condition. Over a period of a year, she was treated with TenderWet, the wound dressing pad being changed twice daily. No disinfectants or wound healing-promoting preparations were used. Despite a lack of causal treatment for the chronic venous insufficiency, the wound condition improved significantly during the course of treatment. Once the TenderWet had cleansed the wound, epithelial tissue formed increasingly. After about a year, the ulcer that had previously been treated without success for 35 years was completely closed.

What is particularly remarkable about this case is that in this multimorbid patient consistent local wound treatment only with TenderWet led to wound closing – despite a lack of causal treatment (Fig. 13). Two observational studies with a total of 51 patients – in the Dermatology Clinic of the Kassel Clinical Center (37 patients) and at the Clinic for Skin Diseases at the University of Jena (14 patients) – back up the positive clinical experience gained with TenderWet. The 37 patients included in the Kassel study had an average age of 66 and suffered from venous leg ulcer (ulcus cruris venosum). They were treated with TenderWet over an average period of 19 days and 33 patients also received significant cleansing of the wound was observed and healthy granulation tissue was seen to form. Due to the good healing process, the patient was discharged after seven weeks, and the dressing continued to be changed daily. After a total of three months, the wound margins were almost apposed and the wound opening was very narrow. Treatment was therefore changed to the hydrogel AquaClear. The wound was completely healed after four months and the patient was able to put full loading on it without difficulty (Fig. 11).
compression treatment. As revealed by assessments of wound condition after completion of the treatment, TenderWet greatly reduced the fibrinous and necrotic coatings and promoted the formation of granulation tissue (Tab. 1). The severity of the exudation also diminished markedly. Whilst at the start of the observational study, 9 patients showed slight exudation, 21 patients moderate exudation and 7 patients severe exudation, at the end there were 29 patients with slight and 8 patients with moderate exudations. Since the wounds were still in the cleansing and granulation stage, during the treatment, only a little epithelial tissue was formed.

To the question of whether dressing changes caused pain, 14 patients answered that they had no pain, 19 reported slight pain and 4 patients cited severe pain. In the opinion of those conducting the trial, the results indicate that TenderWet develops its best effects during the cleansing and granulation stage.

The 14 patients in the observational study at the Clinic for Skin Diseases at the University of Jena also suffered from chronic ulcers. In all the patients, the cause was a chronic venous insufficiency, whilst 6 also had peripheral occlusive arterial disease. The average duration of the disease before they were integrated into the study was 9 months. The patients were treated with TenderWet over an average period of 10 days. Both fibrin coatings and necrotic tissue were significantly reduced during the course of the study while, at the same time, granulation increased. In only one patient there was no improvement in the condition of the wound under TenderWet. The patients tolerated application of the wound dressing pad very well and in none of the patients did the condition of the skin at the wound site worsen. In 5 patients, an existing erythema even improved, whilst in 3 cases, desquamation decreased. As the authors of the observational study emphasised, during the study TenderWet effectively conditioned both the ulcer and its surroundings. After as little as 7-10 days, the wound was sufficiently cleansed for it to be covered, for instance, with a split-skin graft or to continue to treat with a hydrocolloid.

87-year old woman with a classic ulcer in the gaiter area, which persisted for 35 years. 

13a Condition at the start of treatment at home with TenderWet wet treatment on 9/6/94. Causal treatment, such as compression of the leg was no longer possible due to the patient’s general condition.

13b/c Clearly visible – and increasing – improvement of the wound conditions with the beginnings of epithelization.

13d Condition of the leg on 23/5/95, ulcer has closed. Even if it has to be assumed that the wound closing would prove to be unstable in the long term, the healing of the wound with only local wound treatment using TenderWet can be regarded, given the specific patient situation, as remarkable.
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**Burn wounds**

Positive results have also been gathered over the last few years in the use of TenderWet for treating burn wounds. This applies for small partial thickness burn wounds and for residual areas of grafted burn wounds which arise when autografts are partially unhealed. A further important indication are deep dermal burn wounds in which the use of TenderWet in the first few days after the burn reduces the secretion and promotes the wound-healing process, so that epithelial tissue can form more rapidly.

For example, the use of TenderWet aided the wound-healing process in a 22-year old patient who was suffering from full thickness burns. On the left upper limb epithelial tissue was formed and the wound healed within one month. Owing to a mixed infection with Staphylococcus aureus, Escherichia coli and Enterococcus, however, the newly formed epithelial tissue disappeared. After that TenderWet was used. Within four days new epithelium was formed and the wound healed completely (Fig. 14). Also in the case of a 51-year old patient with deep dermal burns, TenderWet helped in the cleansing of the wound and conditioned the wound base for an allograft. Two days post-burn the corium was covered with whitish detritus and other necrotic tissue and the wound severely exudated. After three days application of TenderWet, the clean wound was covered with cultured epidermal allografts. TenderWet was again used in the further course of treatment to protect the graft. Within five days, the wound covered with grafts, healed completely (Fig. 15).

**Wound conditioning before skin graft**

Thanks to its effective cleaning and debriding effects, those patients in whom the wound bed needs to be conditioned before a skin graft also benefit from the application of TenderWet. This is due to the fact that the better the wound bed is cleansed of necrotic tissue, detritus and coatings, the greater is the probability that the graft takes and the wound heals. The effective debriding properties of TenderWet 24 have been shown in a clinical prospective, randomised study with 42 patients. In this study, the cleansing effect of the wound dressing pad was compared with the ef-

![Fig. 14-15](image-url)
factors of enzymatic wound cleansing (using clostridium peptidase). The patients had leg ulcers (ulcera cruris) and were treated over a period of no more than eight weeks either with TenderWet or the enzyme preparation in order to condition the wound base for an autologous skin graft. The two wound cleansing methods proved to be equally effective. Both the moist wound debridement with TenderWet and the enzymatic debridement markedly reduced the level of necrotic tissue and wound coatings, and promoted the formation of granulation tissue. However, the use of TenderWet had the advantage that it not only cleansed the wound, but also kept it moist, absorbed excessive wound exudate and detritus and protected the wound, and thereby provided optimal healing conditions for it.

Numerous published case reports also show that TenderWet conditions the wound base before a skin graft and represents for the patients concerned an effective and pain-free treatment option. A particularly impressive example is the case of a 20-year old woman who had been run over by a lorry, suffering severe pelvic fractures and abrasion of the skin over a large area in the region of the loin, the left buttock and the perineal and anal areas. Following numerous operations, the very large wound area was regularly debrided and disinfected. Due to its size, type and location, the wound became infected with various strains of bacteria. The treating physicians wanted to close the wound as rapidly as possible with a mesh graft. Since for that purpose, the wound base had to be clean and granulating, the wound ground was prepared with TenderWet. For this purpose, the individual TenderWet pads were fixed together with a self-adhesive non-woven to form a large compress of the required size. After a week - with daily dressing changes - the wound base was prepared to the extent that the mesh grafts were able to be applied successfully (Fig. 16). In the case of a 62-year old patient, also, who was suffering from necrotising fasciitis, TenderWet conditioned the wound base for a mesh graft. Following radical surgical debridement and antibiotic medication, the extensive defect areas were covered with TenderWet. The further wound healing proceeded without fault, so that the defect was able to undergo secondary covering with grafts (Fig. 17).

Wound defects after surgical procedures

Following surgical operations, complications in the wound can arise, for example infections or haematomas. Above all, elderly, multimorbid patients with a poor general condition have a high risk level to wound complications. The possibilities for use of TenderWet with wound defects after an operation are illustrated by the following case reports:

A 76-year old patient developed a haematoma at the incision site following an intestinal operation. Once the haematoma had been cleared and the wound rinsed out, TenderWet was applied. After only two days, the wound cavity had shrunk noticeably and after 13 days under TenderWet, the contraction and new formation of granulation tissue had almost raised the wound base to the height of the epidermis. From the 13th day onwards, treatment continued with hydrogel AquaClear, under which the wound was healed after a total of 39 days (Fig. 18). In the case of a dehiscent abdominal wound in an 83-year old patient who had undergone a laparotomy, TenderWet assisted the healing process and prepared the wound base for a skin graft. After the
laparotomy, the surgical wound sutures underwent dehiscence with great quantities of foul smelling exudate. Furthermore, the wound developed a thick necrotic layer. The patient was treated with TenderWet for three weeks, and after only two days, the eschar layer in the wound had reduced by 50%. After 18 days, no necrotic tissue was apparent and over the entire wound bed, healthy granulation tissue had formed. Thereafter, the patient was further treated with hydrogel AquaClear and the wound was then successfully covered with a split-skin graft from the thigh (Fig. 19). Equally successful was the use of TenderWet on a 57-year old patient, who underwent an amputation due to an ischaemia above the knee. Following the operation, a foul smelling wound producing a serous exudate developed. The condition of the wound worsened visibly and relatively large quantities of dead tissue formed on the wound bed in addition to which the wound margins gaped apart. In addition, the wound had become infected with Staphylococcus aureus. TenderWet was applied to absorb the exudate, remove the coatings and to stimulate granulation. After two weeks, the necrotic tissue had fully receded and the coatings had been markedly reduced. The wound bed was covered with healthy granulation tissue and the wound margins had begun to contract. Two months after the start of the TenderWet treatment, the wound had closed to the extent that only a small granulated area remained. From then on, this was packed with Sorbalgon. In just under four weeks, the wound had healed fully (Fig. 20).

Conclusions
Following many years of clinical experience, TenderWet has gained a well-established place in the treatment of problematic wounds. Whenever a chronic, poorly-healing or infected wound has to be cleansed of coatings, necrotic tissue or bacteria-laden exudate, the use of TenderWet is indicated. Due to its absorbing and rinsing effect TenderWet actively cleanses the wound and formation of granulation tissue is promoted. This does not only apply to chronic wounds such as arterial and venous ulcers, decubital ulcer and diabetic foot syndrome. The application of TenderWet has also proved valuable for wound complications, following surgical procedure, for burn wounds and for problematic wounds in which the wound bed needs to be conditioned for a skin graft.
Haematoma after intestinal operation

18a Day 1 (27/3/98) wound condition after partial suture opening, haematoma dissection, tamponing with Betadona gauze and thorough rinsing of the wound cavity with physiological saline solution. 18b-d Start of TenderWet treatment (diameter 5.5 cm). The physical properties of the super absorber in the absorbing core combined with the outer sleeve fabric of the wound dressing pad lend TenderWet its essential tamponing properties, so that it can be relatively easily applied. 18e-g Day 3 (29/3), day 5 (31/3) and day 6 (1/4) show the increased well cleansed wound, formation of granulation tissue has set.

18h On the 13th day after the start of treatment (8/4), the granulation tissue has almost reached the height of the epithelium. 18i TenderWet cannot be tamponed any longer, so that for further promotion of the granulation and epithelium formation, the change-over to hydrogel AquaClear is made. 18j Wound condition after 39 days (4/5/98) with highly developed scar tissue. (In the interim, the patient was discharged from the clinic.)

Amputation wound with post-operative dehiscence

20a Admission findings on 24/1/00, start of TenderWet treatment. 20b 31/1, the necrotic tissue has well detached. 20c 7/2, also the coatings are detached, granulation tissue is visible. 20d 1/3, the wound condition has markedly improved under TenderWet treatment. 20e 22/3, the granulation is now almost at the wound margin level and treatment is changed over to a tamponade with alginates. 20f 16/5/00, complete healing of the wound.