ON THE COVER

Using the SNAP™ Therapy System: A VA Experience

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NOTE: As with any case study, the results and outcomes should not be interpreted as a guarantee or warranty of similar results. Individual results may vary depending on the patient's circumstances and condition.

Up until recently we only had electrically or battery powered devices available for use for our patients. We now have the ability to use a mechanically powered negative pressure therapy system that is ultra-portable and lightweight. The SNAP™ Therapy System weighs 0.1 kg, or about 2.2 ounces and is entirely disposable with no audible alarms and functions with continual negative pressure. The SNAP™ Therapy System is ideally suited to our Veteran's Administration out-patient population for reasons that I articulate below. Many of our veterans are currently suffering with difficult to heal wounds. While exact percentages are difficult to estimate, in my opinion and clinical experience, frequent and multiple comorbidities suggest a higher-than-normal percentage of difficult to heal wounds as compared with a non-VA population. This device is discreet and virtually unnoticeable in social situations. Patient-reported benefits at our center in the cohort of patients we have treated, suggest that it makes minimal noise, is easy to sleep with and has less interference with daily activities.

From a clinical point of view, three different studies by Lerman et al., Armstrong et al., and Marston et al., have all demonstrated the SNAP™ Therapy System. The dressing consists of a blue foam interface that fills the wound. Other products may also be applied to the wound bed if needed. The SNAP™ SecurRing™ Hydrocolloid is fashioned around the wound edge. The sealant layer, which is a proprietary hydrocolloid dressing with an integrated tubing port, is laid down over the wound, the foam and the SNAP™ SecurRing™ Hydrocolloid, and a seal is then assured. The tubing is then connected and cut to the appropriate length so that the cartridge can be inconspicuously placed, either beneath the pants leg, on the belt, or wherever the patient desires. The tubing is also then easily secured such that it minimizes the tripping hazard that may potentially be associated with such treatment modalities. The cartridge comes primed and requires only the removal of the Activation Key to initiate NPWT. Once it has subsequently been connected to the tubing, the SNAP™ Therapy System is ready to go. Because this is an off-the-shelf product, the whole assembly takes just a matter of minutes to connect.

Figure 1: SNAP™ Therapy System components

Let's take a look at a few cases in which our center used the SNAP™ Therapy System. Firstly, we share the case of a 54 year-old male with diabetes mellitus and peripheral vascular disease. The patient had an ulcer on the dorsum of his great toe which resulted in osteomyelitis of the hallux and the 1st metatarsal head (Figure 2). We completed a surgical resection of the 1st ray and after the "clearance", specimens were returned free of bacteria and the SNAP™ Therapy System was applied 10 days post-surgery.

Figure 2:

Figure 3:

The SNAP™ Therapy System was continued for 4 weeks in conjunction with an amniotic membrane dressing. We also applied NPWT at -125 mmHg with weekly cartridge changes. After 4 weeks with the SNAP™ Therapy System, the wound was able to fill completely and 4 additional weeks of grafting resulted in complete closure (Figure 3).

Our second case involves a 67 year old male who presented 3 weeks after a trans-metatarsal amputation. The patient was non-diabetic, had defined neuropathic pain with palpable pulses and a positive probe-to-bone (PTB) test (Figure 4).

Figure 4: Day 0

After one week of SNAP™ Therapy System application, we debrided the wound and placed an amniotic mesh graft under the SNAP™ Therapy System's blue foam (Figures 5A and 5B). The graft and foam were sized to the wound, the hydrocolloid ring was fashioned for quick sealing to the wound surface, the SNAP™ Advanced Dressing was applied and NPWT was commenced.

Figure 5A: Day 7

Figure 5B: Day 7

At 2 weeks post SNAP™ Therapy System application, we noticed a 30% decrease in wound volume and at the 3 week mark, an even more significant reduction in volume of 92% with complete wound closure at Week 4 (Figure 6).

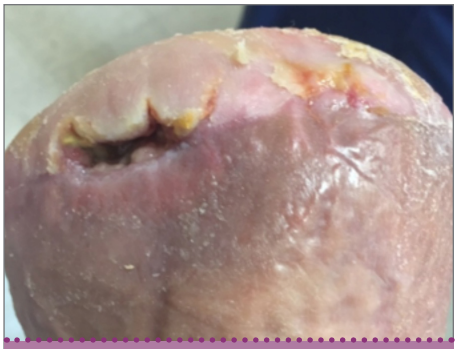

Figure 6: Day 14

Our center's experience with the SNAP™ Therapy System has been a positive one in my opinion given the patient population that we serve where comorbidities and wound complexity may be higher than that observed in a non-veteran population.

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Holistic Wound Care, or "Treat the Whole Patient, Not Just the Hole in the Patient"[1]

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Sir William Osler once wrote, "The good physician treats the disease; the great physician treats the patient who has the disease"[2]. This is no less true of a competent wound care practitioner than a "Father of Modern Medicine".

Chronic wounds are sometimes described as a "silent epidemic" in the American Health System. Often accompanied by co-morbid conditions, they pose a major threat to public health and are a major financial burden on the United States economy.[3] In 2009, it was estimated that 6.5 million patients developed chronic wounds in the United States, with an estimated cost of treatment exceeding $25 billion dollars[3]. This care is increasingly complex and has led to the development of wound care specialist physicians, nurses, and other allied health professionals who, through experience, judicious use of technology and medical care, and clinical acumen attempt to change the disordered and altered wound bed to enable healing. Unfortunately, in spite of sometimes heroic efforts, some wounds may

still remain unhealed. When this happens, it often helps to evaluate more than just the wound and its wound bed/surrounding tissues, but also evaluate the entire patient in a "holistic" sense.

Holistic wound care, or, more appropriately perhaps, holistic care of patients with wounds (acute or chronic) demands a systematic and logical assessment of the patient AND their wound. Understanding the patient in their living conditions, understanding their medical co-morbidities, their nutrition, sleep patterns, level of activity, even their psychosocial/family interactions helps wound care clinicians and specialists develop a comprehensive and more effective wound care plan.

Numerous factors affect wound healing, often divided into intrinsic, extrinsic, and iatrogenic factors. Sometimes these causes overlap but are best organized separately for a deeper and more complete understanding of everything that can lead to chronic wound conditions. Intrinsic factors can include patient age, medical co-morbidities and chronic conditions, all of which potentially have effects on tissue perfusion, oxygenation, and immune status and function. Wound age and size are also intrinsic to the patient and their wound history. Extrinsic factors include medications the patient takes, their nutritional status, any history of localized irradiation or systemic chemotherapy, or current cancer diagnosis, and patient habits, such as tobacco, alcohol, or recreational drug usage. Current psychologic or environmental stressors, including sleep patterns are of importance as well. Additionally, iatrogenic elements- including the wound age and size, as well as the current care treatment regimen- affect the environment of the wound and its subsequent healing potential.

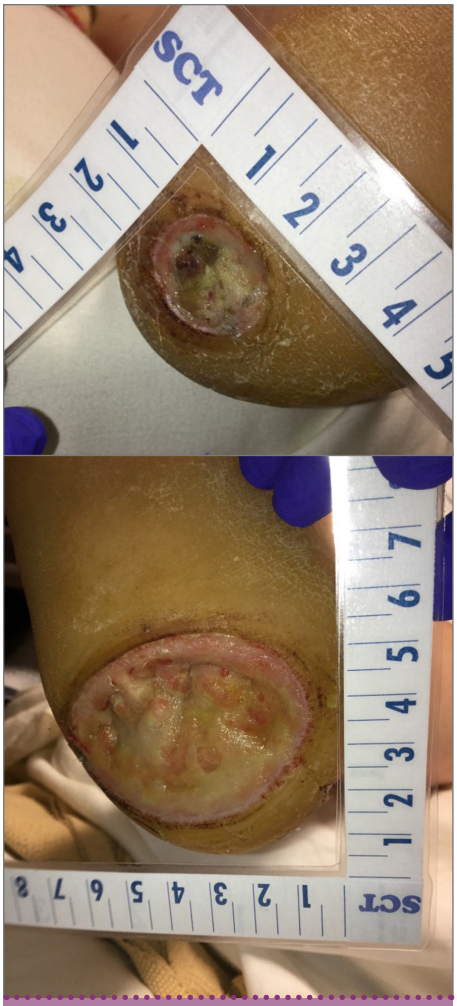
Aging, the presence of chronic disease, and wound development often go together, as aging delays both localized and systemic repair processes, delaying cellular response to injury, impairing collagen and tissue deposition, and reducing the strength of the repaired tissues[4]. This occurs both locally in the open wound as well as systemically in the microcirculatory system. Increasing age, therefore, is often thought of as a marker for the development of wounds and their subsequent delayed healing. Research, however, has shown that healthy older adults without chronic diseases experience only a slight delay in wound healing compared to younger, healthy adults[4]. Only in the elderly population of adults, those older than 85 years old, do we see an absolute increased risk of skin breakdown[4]. In one study, patients 85 or older had an approximate 30% risk of developing pressure ulcers.

Chronic disease conditions, such as diabetes mellitus, peripheral vascular disease, malnutrition, spinal cord injury, and cancer, amongst others, all can lead to chronic wound development and are all critical to diagnose. These differing disease states affect wound healing in varied ways, but all have a negative impact, whether by reducing tissue perfusion, decreasing immune healing response, increasing likelihood of wound development through reduced sensation, or decreasing the ability of the body to fight infection. It should also be noted that the presence of wounds, may lead to stress in the patient. Anatomically and physiologically, there is a close interaction between the endocrine, nervous, and immune systems, studies of which comprise the field of psychoneuroimmunology. This nascent field ties together some of these processes by seeking to understand mind and body interactions, stress-related illness, and, of course, wound healing. For instance, it's well known that stress, fear, pain, or depression can cause the release of "stress hormones" through the pituitary-adrenal axis. Cortisol is released, along with norepinephrine, causing further release of pro-inflammatory cytokines. In the susceptible patient, these inflammatory mediators suppress neutrophil migration and de-margination and inhibit release of Interleukins-1 and 6, which can impair metal metalloprotease enzymes, ultimately decreasing fibroblast proliferation and impairing wound healing[4]. These processes are only magnified in the chronically ill patient already prone to developing a chronic wound.

Evaluating the patient with a chronic wound involves evaluating the wound first. Assessing the wound attributes and the condition of the surrounding skin may give numerous clues to its etiology. Wound location may also help determine etiology, for instance cutaneous ulcerations due to arterial insufficiency are frequently located on the phalangeal heads or the lateral malleolus of the ankle. However, diagnosing the root cause(s) of the wound, which may be multifactorial, often involves further global patient evaluation and may include evaluating blood work to determine glycemic control, nutritional status, or presence of severe inflammatory markers, radiographic studies to assess arterial or venous insufficiency or presence of underlying bony involvement of infection, and possibly cushion or mattress pressure evaluation or mapping to determine offloading needs on areas of bony prominences. Inquiring as to the patient's cardiopulmonary status, and directing efforts at maximizing that status could likewise be helpful. For instance, patients in decompensated heart failure, are unable to deliver oxygen and nutrients to distal areas of the body. Patients with primary or acquired lung conditions like obstructive pulmonary conditions, or even untreated sleep apnea are occasionally unable to oxygenate their tissues due to their reduced ability to oxygenate hemoglobin. Identifying and treating these conditions can frequently contribute to faster wound healing. In summary, wound care is patient care. By identifying and treating both the root causes of issues that either lend themselves to wound development or prevent wounds from healing in the normal, orderly fashion they are meant to, as well as applying appropriate local wound care, success is much more likely.

As an example, we report on the case of a 56 year old male with neuropathic foot ulcers. The patient's past history is significant for morbid obesity with a body-mass index measurement of 45, neuropathy, likely secondary to multiple back surgical instrumentation attempts for severe spinal stenoses, and hypertension. On initial exam, the patient was noted to have bilateral plantar ulcerations on bilateral heels and first toe pads, heel wounds measuring 5 x 7 x 0.8 cm on the right, and 2 x 3.5 x 0.5 cm on the left. The toe wounds were both significantly smaller (see Fig 1, 2, and 3). Treatment ensued with a vascular

Figure 1: Patient's initial presentation with bilateral plantar ulcerations



Figures 2 and 3: Heel wounds measuring 5 x 7 x 0.8 cm on the right, and 2 x 3.5 x 0.5 cm on the left

workup, revealing no arterial or venous insufficiency. A tissue culture and biopsy were obtained in which the cultures revealed intermediate sensitive *S Aureus*, sensitive to Clindamycin. A biopsy showed inflammatory tissue without malignancy. At this stage, we recommended oral antibiotics and local wound care, initially with sharp debridement of hypertrophic callus and silver-based foam dressings were utilized. When the wounds failed to respond appropriately (i.e. with marked -approximate 50%- reduction in size in 4 weeks), numerous wound modalities were attempted, including negative pressure wound therapy, Total-Contact Cast (TCC) Offloading, amniotic membrane placement and repeated short courses of antibiotics. Nonetheless, the wounds failed to respond appropriately over the next 12 weeks and further global evaluation led to a diagnosis of obstructive sleep apnea, with resolution of hypopneic and apneic episodes observed at a continuous positive airway pressure (CPAP) measured at 10 mmHg. This was initiated as home, nighttime therapy. Approximately 4 weeks later, the stalled wounds, being treated with TCC and silver-impregnated foam reduced in size by >50%. At the time of this article (7 months after initial evaluation), the left heel wound is nearly closed (2 x 2 mm) and the right wound measures 1 x 1.5 cm, with no appreciable depth (Fig 4 and 5).

Figures 4 and 5: 7 months after initial evaluation, the left heel wound is nearly closed (2 x 2 mm) and the right wound measures 1 x 1.5 cm

Until we evaluated this patient's baseline pulmonary condition, we were completely unsuccessful in our ability to help heal his foot wounds. Once his sleep apnea was identified and treated, with little difference in wound care regimen, his wounds improved nearly to the point of full healing. In addition, with his apnea and daytime somnolence appropriately treated, the patient relates his energy level has increased markedly, leading to an ability to exercise which, in turn, has lead to weight loss, and improvement in his obesity—elements which are of clear importance in our holistic treatment plan.

In summary, wound care is patient care. Treating "the hole in the patient" without addressing the patient and their comorbidities can lead to stalled or even worsening of wounds which frustrates the patient, their family, as well as the wound care specialist. When a wound has stalled in its healing trajectory, seemingly in spite of maximal and appropriate wound care efforts, stepping back and re-evaluating "the whole patient" can lead to a better and deeper understanding of the wounded patient and their ultimate pathophysiology, potentially indicating further, previously unconsidered treatment approaches that address and treat the underlying cause of the wound.

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