A Case Study for Electrical Stimulation on a Stage III Pressure Ulcer

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Research has shown that tissues in living organisms possess an electrical current. Our skin is negatively charged, and deeper tissues have a positive charge. This electrical system influences wound healing by attracting repair cells, changing cell membrane permeability, enhancing cellular secretion through cell membranes and orientating cell structures.[1] When a break in the tissue occurs, a new current develops between the deep structures and skin. Normally this current continues until the tissue heals. However, chronic wounds lack this current of injury.[2]

Electrical Stimulation (ES) therapy is the use of an electrical current to transfer energy to a wound. It replaces the current that develops endogenously when the tissue is broken, consequently accelerating the healing process. It produces a number of cellular processes and physiological responses that are important to wound healing: stimulation of fibroblasts to enhance collagen and DNA synthesis, an increased number of receptor sites for growth factors, alteration in direction of fibroblast migration, activation of cells in the wound site, improved tissue perfusion, and decreased edema. These cellular responses result in more collagen deposition and angiogenesis, greater wound tensile strength, and a faster wound closure rate.[3]

Treatment protocols for polarity, electrode placement, pulses per second and voltage vary depending on the research study.[4] A safe and effective treatment for chronic wounds is the high-voltage pulsed current, which has a waveform of short-duration, high-intensity pulses with a long inter-pulse interval. The short-duration pulses combined with a long inter-pulse interval produce a very low total amount of current that is sufficient to promote healing.

The electrical current delivery is through a set-up using a wet active electrode made of saline-soaked gauze or hydrogels applied directly to the wound bed. Placement of a larger (two to four times the size of the active electrode) dispersive electrode is on the intact skin ≥ six inches from the wound. Maintaining a moist wound bed is a co-requisite before, during and after the treatment when using ES so that the current flow is sustained.

Numerous clinical studies have demonstrated that ES increases the closure rate of pressure ulcers and ulcers of mixed etiology.[5-10] ES is the only adjunctive therapy with sufficient evidence to warrant recommendation by the Agency for Health Care Policy and Research (AHCPR), the Canadian Association of Wound Care (CAWC) and the Registered Nurses Association of Ontario (RNAO) for use in enhancing pressure ulcer healing.[11-12]

In 1999, the strength of evidence rating increased to a Level A, based on five original randomized controlled trials, plus a 1994 trial.[13] The panel suggested using ES on stage III, stage IV or recalcitrant stage II pressure ulcers when optimum wound healing practices are ineffective.[14]

Recent reports of prevalence of chronic wounds in Canada estimated the prevalence of pressure ulcers to be 25.1 per cent in acute-care settings, 29.9 per

A detailed version of the case history outlined in this article can be found in the *Wound Care Canada* section of the CAWC Web site at *www.cawc.net*.

cent in non-acute facilities and 15.1 per cent in patients in home-care settings. Various studies estimate the cost to heal one ulcer ranges from U.S. $5,000 to $25,000, and the total financial burden runs well over U.S. $5 billion annually.[6] These figures do not address the issues of quality of life, pain or deconditioning for the client who cannot physically afford immobilization in bed for an extended period.

Due to the huge number of variables, it is difficult to find consistent timeframes as to when pressure ulcers should be closed. General clinical expected outcomes of treatment are a 20–30 per cent decrease in size within two to three weeks. The goal of treatment is accelerated wound closure, along with resumption of normal activity and level of participation.

Clients interested in a more conservative approach to accelerated wound closure versus surgical repair have the option of adjunctive therapies. This case presentation highlights an interdisciplinary approach to the delivery of ES in conjunction with optimal wound management that resulted in wound closure within 12 weeks. Wound tracings and photography tracked the progress of wound closure every one to two weeks.

The Web Connect component of this article gives a detailed case history of Mrs. L., an active 54-year-old widow with complete T7/8 paraplegia following a traumatic motorcycle accident more than 30 years ago. She sustained a stage III pressure ulcer on her left ischial tuberosity following a traumatic transfer from wheelchair to toilet. An overview of the case study follows.

An interdisciplinary team meeting convened in the client's hospital room to discuss her care once she was discharged. The team included the client, a wound specialist from the hospital, a physiotherapist consultant specializing in the treatment of chronic wounds, a hospital physiotherapist, a community wound ostomy continence nurse (WOCN/ET) and a case manager from the Community Care Access Centre (CCAC). Key issues identified during the meeting were as follows:

- Pressure off-loading of wound
- Reduce further injury by adjusting transfers – assess and educate PSW and patient
- Standard wound-care practices must be followed (clean, maintenance of a moist wound bed, debridement, protect peri-wound tissue)
- Physiotherapist consultant to develop a treatment protocol for the home
- Client to order equipment and arrange delivery
- ES to be applied at each dressing change, on daily basis
- Physiotherapist consultant to train nurse doing daily dressing changes how to set up ES and apply preset parameters
- Need for continuity of care in the community by having one or two nurses doing most dressing changes and applying ES
- Regular reassessment by the physiotherapist consultant to assess wound closure and adjust treatment parameters accordingly. This was required on a weekly basis initially and subsequently occurred bimonthly.


FIGURE 1
ES therapy set-up

Results: Wound Healing

The initial size of the wound when Mrs. L. arrived home was 9.3 cm^2 (see Figure 2). The pressure ulcer progressively decreased in size over the next three weeks to 6.7 cm^2. However, closure was limited due to persistent undermining. The wound size increased with de-roofing during week six. Subsequently, rapid wound healing followed over the next four weeks with complete closure during week 12 (see Figure 3).

Costs

Total cost for this 12-week community wound-care program was $27,632 or approximately $9,000 per month. Approximately half of the costs were incurred by the client herself. The cost of the ES was $1,477.46, which was relatively minimal considering overall costs. These costs included reimbursement for professional and support staff, wound-care supplies, rental of equipment and loss of potential income.

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Stage III pressure ulcer prior to onset of ES therapy.

Stage III pressure ulcer after 12 weeks when wound had closed.

Discussion

The wound closed 22.58 per cent the first week Mrs. L. was home from the hospital. By week three, the wound had only closed an additional 6.9 per cent. Following the de-roofing, the wound decreased in size an average of 56.38 per cent per week.

Rather than obtaining the expected clinical outcome of a weekly 10 per cent decrease in the size of the wound, we achieved more than five times the expected rate following de-roofing.[17] We anticipate the time for wound closure would have been much faster had the de-roofing procedure been available sooner than six weeks post discharge. De-roofing during the course of treatment initially created a negative impact on wound measurements. However, including de-roofing as a negative value still results in an overall average of 19.85 per cent decrease in wound size per week over the 12-week period. Results remain more than twice the anticipated clinical outcome.

Costs associated with treating pressure ulcers in the community are significant. Previous accounting of their costs to the Canadian health-care system is not available. Even with an accelerated wound closure rate induced by ES therapy, total costs are approximately $9,000 per month. The financial burden that this medical condition imposes on the patient is also significant. Fortunately, this patient was able to afford the additional costs and to employ private services for ES therapy. Clearly, the cumulative costs would have continued to increase had the wound remained open for a longer period of time.

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