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Case Report

Accelerated Healing of Sacral Wound in a Rehabilitative Paraplegic Patient with Electrical Microcurrent Therapy: A Case Report

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Abstract

Introduction: This case report demonstrates that electrical microcurrent therapy (EMT) is both efficient and effective in enhancing wound healing both in simple and complex wounds. EMT uses low-intensity currents placed across a wound. This treatment leads to a faster cure and healing of the wound. And, return to a standard, painless state. Wound care in a rehabilitation environment is a costly and challenging problem. This case report translates into improved patient care and significant cost savings. **Patient Concerns**: This report is of a 54-year-old paraplegic male. The patient had a stage 3 decubitus ulcer. This type of wound is very common in spinal cord injury patients (SCI). The patient had a stable, non-healing wound that developed four years after his spinal cord injury. In a significant percentage of patients with this type of injury, there is minimal to no improvement with standard-of-care therapy. Paraplegic spinal cord injury patients are at high risk for pressure injury wounds. There is a significant risk for infection, morbidity, mortality, and increased healthcare costs. **Diagnosis case report**: Sacral Stage 3 Decubitus Pressure Ulcer. **Interventions case report:** The patient underwent a total of 10 electrical microcurrent treatments over the course of 5 weeks. Each treatment session lasted approximately 30 minutes and was conducted twice a week. **Outcomes**: With EMT, this wound was healed with 10 treatments over a 5-week time period. This is half the time needed with the current standard-of-care if it is to heal at all. **Conclusion**: Improved methods such as this are slowly being developed. Advanced wound therapies, such as EMT, are typically introduced after standard-of-care approaches fails. The time has come to consider this type of treatment early on in caring for complex wounds.

Keywords: EMT-Electrical Microcurrent Therapy; tSCI-Traumatic Spinal Cord Injury; PU-Pressure Ulcer; SOC-Standard of Care

Introduction

EMT involves the application of a low-level electrical current to stimulate tissue healing and regeneration. This therapy has been used for various conditions, including pain management, tissue healing, and muscle stimulation. In the context of complex wound healing, EMT is effective in promoting tissue regeneration and reducing inflammation. EMT stimulates the production of adenosine triphosphate (ATP), which is the energy source for cellular metabolism. This increased cellular energy production can stimulate the healing process by promoting cell proliferation and tissue regeneration. Additionally, EMT can improve blood flow to the affected area, which can aid in the delivery of nutrients and oxygen to the wound. The 2022 population size in the United States was estimated to be about 334 million. The most recent estimates of the annual incidence of tSCI are approximately 54 cases per one million people in the United States, which equals about 18,000 new tSCI cases annually [1,2]. Annually, 12,500 people survive spinal cord injuries (SCI). Most of these SCIs are caused by car accidents (38%), followed by falls (30%), violence (14%), sports and other recreational activities (9%), medical errors (5%), and various other factors (4%), according to the National Spinal Cord Injury Statistical Center [1]. SCI patients have a high risk of acquiring pressure ulcers because of motor and sensory impairments, immobility, changes in skin composition, and prolonged length of hospital stays. Pressure wounds are a substantially expensive and chronic problem of SCI. Roughly 30–40% of SCI patients develop pressure ulcers through acute and rehabilitation hospitalizations [2]. Wound care in inpatient settings is costly and complicated when treated only with wound SOC. A two-center retrospective study by Whitcomb [3] established a 45.5% shorter healing of wounds using a microcurrent-generating wound device (MCD) compared to a wound SOC during the rehabilitation phase. This two-center study showed that the wounds in the SOC group closed on average at 36.25 days (SD = 28.89), while the MCD group closed significantly faster at 19.78 days (SD = 14.45), $p = 0.036$. The daily volume reduction rate was – 3.83% for SOC vs. – 9.82% per day ($p = 0.013$) for the MCD group. The SOC group had 50% of its wounds close monotonically vs. 83.3% in the MCD group ($p = 0.018$). This improves patient care and potentially significantly lower healthcare costs [3,4].

Case Presentation

The patient is a 54-year-old male who has been a paraplegic for 4 years following a traumatic spinal cord injury. He had no history of sacral pressure ulcers; however, his current wound had been present for 3 months. The wound length, width, and depth measured 9.00 cm x 6.0 cm x 1.1 cm and was classified as a stage three pressure ulcer, as noted in Figure 1. The pressure ulcer had progressed beyond the superficial layers of the skin and into the underlying tissue. At this stage, the wound appears as a deep crater with a depth of up to several millimeters. The wound bed contains slough; the edges are irregular, and odor is present. The patient was referred to our wound care center to manage his sacral wound. After a thorough evaluation, it was determined that electrical microcurrent treatment would be an appropriate treatment modality for this patient's wound. The patient's medical history was unremarkable; no premorbid conditions were reported, and the only complications were related to his current neurogenic bowel and bladder. The patient current level of function was limited to minimal assistance with transfers mobility and supervision with all activities of daily living. The patient underwent a total of 10 electrical microcurrent treatments over the course of 5 weeks. Each treatment session lasted approximately 30 minutes and was conducted twice a week. After completing the treatment plan, the patient's sacral wound had completely healed. The patient reported a significant decrease in odor and improved overall quality of life. The patient reported no adverse events throughout the treatments. The patient reported significant improvement in his quality of life and his activities of daily living secondary to the accelerated healing of his sacral wound. The patient has provided informed consent for the publication of the case. Follow-up measurements and treatment progress are appreciated chronologically in Figures 1-5.

Figure 1: Represents the initial wound picture presentation on 03 November 2022, measuring 9x6 cm.

Figure 2: Represents the follow-up EMT treatment day 12 on 15 November 2022, measuring 7x5 cm.

Figure 3: Represents the follow-up EMT treatment day 20 on 23 November 2022, measuring 4x2 cm.

Figure 4: Represents the follow-up EMT treatment day 26 on 29 November 2022, measuring 2x1 cm.

Figure 5: Represents the follow-up EMT treatment day 32 on 05 December 2022, wound healed.

Discussion

Electrical microcurrent therapy is a non-invasive, painless, and safe treatment modality that has been shown to accelerate the healing of wounds. The use of electrical microcurrent therapy in treating pressure ulcers has been well documented in the literature. This case report demonstrates the effectiveness of electrical microcurrent therapy in healing a sacral wound in a paraplegic patient. Electrical microcurrent therapy is a valuable addition to the wound care armamentarium and should be considered a treatment option for patients with pressure ulcers. Wound dimensions and photographs were recorded at the beginning of the treatment and interim and final patient visits. Linear wound dimensions, including length (l) and width (w) were measured by a paper ruler. Wound closure progression was also documented through digital photography under standard photographic requirements. The percentage wound volume change per day was calculated using the following expression formula: (Wound Volume on Day 0 -Volume last day) x 100/Total days of wound care.

Microcurrent Stimulation and Wound Care

The wound care device used for the present study consists of a discrete matrix of silver (Ag) and zinc Zn) dots placed on a pliable polyester substrate. In the presence of an ionic fluid, such as normal saline, administered on the device prior to application or the ionic environment by wound exudate, a sustained voltage of approximately 0.8 Volt is generated between the Ag and Zn dots [2,5]. The electric field generated at the device surface is measured to be 0.2–1.0 Volt, 10–50 µ A. Such a field is comparable to the transcutaneous voltage potentials developed in injured skin [6]. Microcurrents resulting from Ag electrodes have been reported to enhance wound healing in a number of studies in vivo and the clinic. For example, Alvarez et al [7] reported significantly faster healing of wounds in a porcine model when an Ag electrode delivering a direct current of 50 µA–300 µA was activated, compared to when the electrode was not energized. As another example, Huckfeldt et al [8] reported a 39% improvement in wound closure for patients having full-thickness skin burns in a 30-patient study when an anodic microcurrent is delivered using a flexible silver electrode construct. The cathode was a return pad placed on uninjured skin. Electrical stimulation (ES) has been evaluated for improving wound healing for decades and some clinical practice guidelines recommend their use for accelerating the healing process of wounds [7]. In a similar study, the Mayo Clinic experience 2004-2006 treatment of ischemic wounds with noncontact, low-frequency ultrasound concluded that the healing rate of cutaneous foot and leg ulcerations in patients with chronic critical limb ischemia improved significantly when MIST Therapy was combined with the standard of wound care [11]. The use of electroceutical devices (ECDs), which provide continuous electrical stimulation to wounds, appeared to be safe, effective, and cost-effective methods for treating severe, complex, and challenging wounds, including hard-to-heal, surgical wound incisions, and skin graft donor sites [9]. In chronic wound care, bacterial colonization, biofilm production, and infection are substantial global problems compounded by the increased incidence of MDROs in patients' wounds. Chronic wounds have a complex microenvironment that houses multiple bacterial species. There is a lack of evidence on the effectiveness of antibiotic therapy in chronic wounds, optimal regimens, or specific clinical indications for treatment [5]. The wound-healing process consists of complex phases that begin right after an injury, and there are interaction effects of electrical stimulation on angiogenesis and blood circulation [10]. There is an interaction between several tissues and cells. The most crucial steps occur during the proliferative phase, ensuring the successful closure of the wound. In this phase, the formation of new blood vessels occurs through the bifurcation and extension of existing capillaries, an indispensable process for successful wound healing [11]. Electrical stimulation has induced critical pre-angiogenic responses in vitro mature endothelial cells between several tissues and cells. The most crucial steps occur during the proliferative phase, ensuring the successful closure of the wound [5,12]. In this phase, new blood vessels form through the bifurcation and extension of existing capillaries, an indispensable process for successful wound healing [7, 13]. ES has induced meaningful pre-angiogenic responses in vitro mature endothelial cells [6].

Conclusion

The results of this case report demonstrate that the utilization of EMT is an effective, safe treatment for improving wound area, healing time, and pain. Further clinical trials that include detailed intervention parameters and protocols should be designed to lower the risk of bias. This case report supports the conclusion that incorporating EMT as a standard of care for acute and chronic wounds improve healing by reducing the wound area and time to complete healing, with moderate and low certainty in the evidence. Furthermore, EMT reduces pain perception and has proven a safe technique with few minor side effects. The effect of the healing time can be of particular importance in chronic wounds or those with more significant healing problems.

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