Electrostimulation and Electromagnetic Therapy for the Treatment of Wounds

Effective: August 1, 2018

Next Review: June 2019
Last Review: June 2018

IMPORTANT REMINDER

Medical Policies are developed to provide guidance for members and providers regarding coverage in accordance with contract terms. Benefit determinations are based in all cases on the applicable contract language. To the extent there may be any conflict between the Medical Policy and contract language, the contract language takes precedence.

PLEASE NOTE: Contracts exclude from coverage, among other things, services or procedures that are considered investigational or cosmetic. Providers may bill members for services or procedures that are considered investigational or cosmetic. Providers are encouraged to inform members before rendering such services that the members are likely to be financially responsible for the cost of these services.

DESCRIPTION

Electrical stimulation refers to the application of electrical current through electrodes placed directly on the skin in close proximity to the wound.

MEDICAL POLICY CRITERIA

*Note: Electrical stimulation as a treatment of pain and other musculoskeletal conditions are considered in separate plan Medical Policies. See Cross References.

Electrical stimulation and electromagnetic therapy for the treatment of wounds is considered investigative. All electrical stimulation devices are included in the category, including but not limited to, low-intensity direct current (LIDC), high-voltage pulsed current (HVPC), alternating current (AC), and transcutaneous electrical nerve stimulation (TENS)*.

NOTE: A summary of the supporting rationale for the policy criteria is at the end of the policy.

CROSS REFERENCES

1. Electrical Stimulation Devices Index, DME, Policy No. 83
BACKGROUND

Electrostimulation (electrical stimulation) refers to the application of electrical current through electrodes placed directly on the skin. Electromagnetic therapy involves the application of electromagnetic fields, rather than direct electrical current. Both are proposed as treatments for wounds, generally chronic wounds.

The types of electrical stimulation and devices can be categorized into four groups based on the type of current:

- Low intensity direct current (LIDC)
- High voltage pulsed current (HVPC)
- Alternating current (AC)
- Transcutaneous electrical nerve stimulation (TENS)

Electromagnetic therapy is a related but distinct form of treatment that involves the application of electromagnetic fields rather than direct electrical current.

The normal wound healing process involves inflammatory, proliferative and remodeling phases. When the healing process fails to progress properly and the wound persists for longer than one month, it may be described as a chronic wound. The types of chronic wounds most frequently addressed in studies of electrical stimulation or electromagnetic therapy for wound healing are ulcers, and include but are not limited to, pressure, venous, arterial, and diabetic.

Conventional or standard therapy for chronic wounds involves local wound care as well as systemic measures including debridement of necrotic tissue, wound cleansing, and dressing that promote a moist wound environment, antibiotics to control infection and optimizing nutritional supplementation. Wound care may be conducted by medical professionals in the clinical or home setting, or by patients themselves, typically in the home setting.

REGULATORY STATUS

At the present time there are no electrical stimulation devices that have received U.S. Food and Drug Administration (FDA) approval specifically for the treatment of wound healing. A number of devices have been cleared for marketing for other indications. Use of these devices for wound healing is an off-label indication.

EVIDENCE SUMMARY

The principal outcomes associated with treatment of wounds, particularly chronic wounds, are complete wound closure, improvement in the rate or quality of healing (such as the minimization of scarring), treatment of infection, and patient-centered outcomes such as improvements in function or mobility, and minimization of pain.[1,2] Outcomes relating to the use of a device delivering electrical stimulation or electromagnetic therapy for the treatment of wounds are best understood when comparing use of either type of device to a sham device among patients with similar wound type (i.e., burn or chronic diabetic ulcer), who are receiving standardized wound care regimens. Therefore, data from adequately powered, blinded, randomized sham-controlled trials are required to control for bias and determine whether any
treatment effect from electrical stimulation or electromagnetic therapy devices provides a significant advantage over standard wound care.

SYSTEMATIC REVIEWS AND TECHNOLOGY ASSESSMENTS

A 2017 Health Technology Assessment completed by Health Quality Ontario evaluated the effectiveness of adding electrical stimulation to standard wound care for pressure injuries. Nine randomized controlled trials and two non-randomized controlled trials were identified. No significant difference in complete pressure injury healing was identified between adjunct electrical stimulation and standard wound care. Pooled data from four studies indicated electrical stimulation was significantly superior for wound surface area reduction, although GRADE quality of evidence was low. Overall, electrical stimulation was found to be safe to use (GRADE quality of evidence: high), but it is unclear whether it improves wound healing (GRADE quality of evidence: low).

A 2017 meta-analysis by Khouri included 29 randomized trials (total N=1510 patients; total N=1753 ulcers) of individuals treated with electrostimulation, sham stimulation, or standardized wound care. The primary finding was a highly heterogeneous overall standardized mean difference (SMD) of 0.72 (95% CI, 0.48 to 1; I²=78%). Modalities were varied: in 18 studies, active electrostimulation was placed near the wound, and in 17 studies, electrostimulation was placed over the wound; additionally, types of waveform varied between studies (types included direct, high, or low voltage current, and alternating current). Electrostimulation had greatest efficacy when the active electrode was over the wound and high-voltage pulsed current was used (SMD=0.8; 95% CI, 0.38 to 1.21; I²=79%). Other factors that may have affected the efficacy of electrostimulation were ulcer type, size, and duration (small, quick-healing pressure ulcers were favorable), although the association was not statistically significant (p=0.28). In subgroup analyses, reviewers found a greater sensitivity for wound size area than for other outcomes. Potential sources of heterogeneity were electrode polarity, ulcer etiology, and type of outcome. Reviewers noted that 52% of the studies had a high risk of bias, but concluded that the overall safety and efficacy of electrostimulation seem confirmed, given the current evidence.

Aziz and Bell (2015) published a SR update that assessed the effects electromagnetic therapy (EMT) versus sham EMT on the healing of pressure ulcers. No new RCTs were identified and of the two included, there was no significant differences in complete wound healing between the groups. One RCT identified a significant reduction in wound surface area with EMT treatment. The authors concluded there was no strong evidence to support EMT for the treatment of pressure ulcers and the one study that showed EMT effective in the treatment of pressure ulcers was small. Both RCTs had methodological limitations.

Aziz and Cullum (2015) published results from a systematic review (SR) that assessed the effects of electromagnetic therapy (EMT) on the healing of venous leg ulcers. Three randomized controlled trials were included were included in the review comprising 94 people. All trials included in the review compared the use of EMT with sham-EMT; however, due to heterogeneity a meta-analysis could not be completed. Two of the trials included in the review reported a significant finding on healing with the EMT group. The first study included 44 participants and reported that significantly more ulcers healed in the EMT group when compared to the sham-EMT group; however, the authors reported there were a number of participants that were lost to follow-up making it challenging to determine significance in wound healing. The second study comprised 31 participants and reported a significantly greater
reduction in ulcer size in the EMT group; however, the authors reported this result was likely influenced by the differences in prognostic profiles of the treatment groups. The third study included in the review found no significant difference in healing. Based on these findings, the authors concluded that it is unclear whether EMT therapy influences the rate of healing of venous leg ulcers; therefore, further research is needed to determine the efficacy of EMT treatment on wounds.

Kuffler (2015) published results from a review that examined the different standards and novel techniques that have been tested for eliminating pressure ulcers.[7] Electrical stimulation was included in the review, and the author reported that although different types of electrical stimulation have been used to promote wound healing these studies are limited due to the lack of high-quality well-designed studies. Therefore, more high-quality studies are needed to determine the efficacy of electrical stimulation on wound healing.

The National (NICE) published a SR that evaluated the effectiveness of electrotherapy for pressure ulcers.[8] Fourteen studies were included. NICE concluded the studies had methodological limitations, including small sample sizes. NICE therefore does not recommend electrotherapy for pressure ulcers, unless part of a clinical trial.

Barnes (2014) published the only SR to date which pooled study findings from RCTs evaluating the effectiveness of electrical stimulation for chronic ulcers of any etiology compared with standard treatment and/or sham stimulation.[9] Twenty-one trials were included in the review; 14 used pulsed currents, five used alternating currents, and two used direct currents. Types of ulcers examined were pressure ulcers in 11 studies, venous ulcers in three studies, diabetic ulcers in two studies, arterial ulcers in one study, and ulcers of mixed etiology in the remaining four studies. Only five of the 21 trials were rated as ‘good’ quality i.e., a score of 4 or 5 on the Jadad scale. Studies generally did not report the clinically important outcomes of percent completely healed or time to complete healing. Instead, they tended to report outcomes related to the decrease in the size of wounds. Meta-analyses were performed on several of these secondary outcomes. A pooled analysis of six studies with a total of 201 patients found that electrical simulation increased the mean percentage change in ulcer size by 24% to 62% compared with standard care and/or sham stimulation. The difference between groups was statistically significant, p<0.001, and heterogeneity among trials was not significant. Another pooled analysis of six RCTs with a total of 266 patients found that electrical stimulation resulted in a significantly greater reduction in mean absolute ulcer size compared with standard care and/or sham stimulation. The mean difference in size between groups was 2.42 cm² (95% confidence interval [CI], 1.66 to 3.17, p<0.001) and there was significant heterogeneity. The authors conducted sensitivity analyses and the significant benefit of electrical stimulation on ulcer size remained when studies on pulsed current and direct current were analyzed separately. Limitations of the evidence evaluated in the review include few high-quality studies, variability in study designs, and lack of data on complete healing.

Other SRs were less comprehensive and did not conduct quantitative meta-analyses. Liu (2016) published a SR assessing of electrical stimulation settings affect pressure ulcer wound healing for patients with spinal cord injuries.[10] The SR evaluated six RCTs and two nonrandomized clinical controlled trials. The study concluded pulsed direct current ES on pressure ulcers was more efficacious than constant direct current ES. ES increased wound healing and pressure ulcers receiving ES were less likely to worsen. The authors concluded that well-designed clinical trials involving larger sample sizes need to determine the optimal benefit on health-outcomes.
A 2014 SR by Kawasaki et al addressed electrical stimulation only for pressure ulcers.\[11\] The authors identified seven RCTs and two observational studies that included at least 15 patients. The authors found the greatest amount of support for high-voltage pulsed current. Another SR, by Liu (2014), identified six RCTs evaluating electrical stimulation for treating pressure ulcers in people with spinal cord injuries.\[12\] Both reviews concluded that electrical simulation was effective for wound healing. Conclusions were largely based on secondary outcomes reported in studies such as change in wound size and interface pressure, rather than on complete healing.

The Agency for Healthcare Research and Quality (AHRQ) (2013) published a comparative effectiveness review to evaluate the optimal treatment strategy for pressure ulcers.\[13\] Although the group considers complete wound healing to be the primary outcome of interest, wound improvement was also considered, as “it represents a necessary intermediate step toward the principal outcome of complete wound healing…(and) the likelihood of complete wound healing is lower for larger or higher staged ulcers.” A moderate and low recommendation for acceleration of healing and wound improvement was given to electrical stimulation and electromagnetic therapy, respectively. A moderate strength of evidence was defined as, “moderate confidence that the evidence reflects the true effect. Further research may change our confidence in the estimate of effect and may change the estimate.” Low was defined as, “low confidence that the evidence reflects the true effect. Further research is likely to change the confidence in the estimate of effect and is likely to change the estimate.” However, the agency did note that while electric stimulation and electromagnetic therapy show a tendency toward wound improvement, neither demonstrated consistent effectiveness in complete wound healing.

Additional SRs have been identified which assessed the effects of electrical stimulation upon wound healing; however, all of these reviews were limited by a lack of large, long-term RCTs with which to conduct robust pooled analyses of study findings.\[14-20\] In addition, the results of these published reviews provided conflicting results, with some reporting no difference between groups.

**RANDOMIZED CONTROLLED TRIALS**

Khooshideh published a 2017 RCT of 72 women who were treated with pulsed electromagnetic field (PEMF) therapy or sham PEMF following Cesarean section.\[21\] The primary outcome was reduction of pain during recovery, which was assessed using visual analog scale (VAS) at regular intervals for seven days following surgery. At each assessment, women treated with PEMF (n=36) reported significantly lower levels of pain than did their counterparts treated with sham (n=36). For example, two hours after surgery, PEMF patients had a mean VAS score of 53 compared with a VAS score of 63 for sham patients (p=0.01). Comparisons were similar between groups through the seventh day of follow-up, when the PEMF group reported mean VAS score of 0.8 and the sham group reported mean VAS score of 3 (p=0.01). The percentage of patients who reported severe pain (defined as VAS score of ≥75) 24 hours or less after surgery was lower in the PEMF group (36%) than in the sham group (72%; p=0.002). Secondary outcomes were wound healing and use of the pain medication available to each patient at discharge (diclofenac suppository 100 mg as needed); unlike other outcomes, wound healing was assessed 10 days after surgery, rather than 7. None of the patients in the PEMF group showed signs of wound exudate or edema, compared with 13% and 11% of sham patients who had exudate or edema, respectively (p=0.04). Patients in the PEMF group consistently used fewer suppositories to treat postoperative pain.
than those treated with sham: the mean number used by PEMF patients during the follow-up period was 1.7, whereas sham patients used a mean of 3.7 (p<0.001). Patients in both groups took an average of three to four days before they were able to resume normal activities, with no significant difference between groups (p=0.58). Given the favorable outcomes for PEMF as treatment for pain following C-section, the authors recommended that further studies also investigate any effect on lactation and interaction between mother and infant, but listed no limitations to their study other than a change from 10 days of follow-up to 7.

In 2017, Polak conducted an RCT in which 63 patients were randomized to cathodal or anodal electrostimulation with high-voltage monophasic pulsed current (HVMPC) or sham stimulation.[22] All patients had pressure ulcers of 0.5 cm2 or greater on the pelvic girdle, and most patients (n=49; 77.78%) were immobile; also, regardless of the regimen administered, standard wound care was given to all patients. Of patients who received HVMPC, 23 were given daily 50-minute treatments of cathodal electrostimulation five times per week for six weeks; a comparator group (n=20) was given cathodal stimulation for one outcomes was observed between cathodal and cathodal-anodal groups, although outcomes in both groups were significantly superior to those for the group receiving sham stimulation. Decreases in wound size area of 82.34% and 70.77% for the cathodal and cathodal-anodal groups, respectively, were significantly larger than the decrease observed in the placebo group (40.53%). Similarly, the HVMPC groups achieved a 50% decrease in wound size area faster (1.92 weeks and 2.60 weeks) than the sham group (10.60 weeks). During the six weeks of treatment, 47.83% of wounds treated with cathodal stimulation closed, as did 45% of those treated with cathodal-anodal stimulation. For the sham group, none of the patients achieved full wound closure at six weeks. This result suggests that the active stimulation protocols were comparable in efficacy and superior to standard wound care. Limitations of the study were that the authors did not confirm blinding rates or follow patients to complete wound closure, so the optimal treatment time was not determined.

Polak (2016) published a RCT evaluating the effectiveness of high-voltage monophasic pulsed current (HVMPC) on stage II and II pressure ulcers. Twenty-five patients received electrical stimulation (ES) for 50 minutes five times a week for six weeks and an additional 24 patients received sham treatments during that time. Wound surface area was evaluated at one week and six weeks. The ES group showed significant improvement over sham treatments, but the authors concluded there were methodological limitations with this study including customization of patient care, short study timeframe, and the fact there were no stage IV pressure ulcers. Further studies are needed to determine the efficacy of this treatment.

Franek (2012) published an RCT that investigated the effects of high-voltage electrical stimulation (HVES) on nonhealing, lower-extremity, stage II and stage III pressure ulcers.[23] All patients received standard supportive care and topical treatments covered with wet-to-moist dressings. Patients in the treatment group also received HVES (100 V; 100 μs; 100 Hz) continuously for 50 minutes a day, five times/week. Fifty-seven patients were recruited over a four-year period of which 50 patients (88%) completed treatment. Although improvement was observed in both groups, wound area, linear measurement, wound volume, and granulation tissue changes were statistically significantly greater in the treatment than in the control group. At the end of the six-week follow-up, surface area change was 88.8% (SD 14) in the treatment group and 44.4% (SD 63.1) in the control group (p=0.00003). Wound healing was not reported due to the short six-week follow-up period. Limitations of this study included the small sample size and limited follow-up time which preclude conclusions about the effectiveness of HVES as a treatment for lower-extremity pressure ulcers. In addition, authors noted that further
research was needed to determine the optimal duration of treatment and type of HVES stimulation.

Ud-Dine (2012) conducted a small randomized study on electrical stimulation treatment for acute cutaneous wounds.[24] Twenty patients, with a mean age of 23 years, underwent temporal punch biopsy in both arms at different time periods in the study. Patients were then randomized to receive localized electrical stimulation in either the right or left arm. An improvement in melanin and hemoglobin levels was observed in the treatment group over the observation group. However, this study is limited by its small sample size and a lack of data regarding wound healing.

Houghton (2010) published an RCT on a small (n=34) RCT comparing pressure wound healing (as measured by reduction in wound size at three months) with and without use of electrical stimulation on a group of patients with spinal cord injury in a community-based home setting.[25] Following three months of treatment (where patients, family members, and/or home care nurses were responsible for delivery of electrical stimulation with the Micro-Z™ device [Prizm Medical, Inc.]), the group receiving electrical stimulation in addition to standard wound treatment reported a significantly greater decrease in wound surface area compared with the treatment group receiving standard wound treatment alone (mean decrease: 70% vs. 61%, respectively, p=.048). (Of note, the Micro-Z device has clearance from the FDA for use in pain relief; wound treatment is an off-label use of this device.) Although the difference in wound size between treatment groups (9%) attained statistical significance, the clinical significance of such a difference was not reported. Secondary outcomes included difference in number of patients who had attained complete wound closure at six months; no significant difference was found between the treatment groups (six patients in the electrical stimulation group versus five in the standard wound care group attained complete wound closure). These results are limited by lack of comparison with a sham treatment group. A comparable sham control group would help control for placebo effects as well as for the variable natural history of wound healing. Additionally, study of intermediate health outcomes (i.e., comparisons in proportion of wound healing) does not permit conclusions about improvement in short- or long-term primary health outcomes (such as complete wound closure). Although no statistical difference was found in complete wound closure between the treatment groups, the study may not have been sufficiently large to detect such a difference. Studies with larger sample sizes and longer duration may be required to evaluate whether treatment difference exists.

Adunsky (2015) published a randomized, double-blind, placebo-controlled trial to determine the benefits of adding direct current electrostimulation to conservative wound care for stage-III degree pressure sores of 30 days to 24 months duration.[26] This multicenter trial of 63 patients found no significant differences in complete wound closure or time to complete wound closure between the treatment groups after eight consecutive weeks of electrostimulation. Nor were there any significant differences between groups after an additional follow-up of 12 weeks. While the authors reported an increase in absolute wound area reduction and speed of wound healing up until the 45th day of treatment in the electrostimulation group, this was not statistically significant and did not result in a greater rate of complete wound closure.

**SUMMARY**

Many studies on use of electrical stimulation reported short-term outcomes such as wound healing rate or decrease in wound size; several of the included trials found improvements for these outcomes. However, few studies evaluated complete healing or time to complete
healing, two more clinically important outcomes. Systematic reviews were limited by the inclusion of studies with poor methodological quality and high heterogeneity. The evidence is insufficient to determine the effects of the technology on health outcomes.

The reviews on use of electromagnetic therapy were limited by the inclusion of small studies and a lack of robust pooled analyses. The one RCT was on this topic focused primarily on postoperative pain, with wound healing being a secondary outcome that was assessed according to a previous protocol. The evidence on use of electromagnetic therapy to treat wounds is inadequate to support conclusion about efficacy.

**PRACTICE GUIDELINE SUMMARY**

**AMERICAN COLLEGE OF PHYSICIANS**

The American College of Physicians (ACP)\(^{[27]}\) (2015) published guidelines regarding the treatment of pressure ulcers and recommended, “that clinicians use electrical stimulation as adjunctive therapy in patients with pressure ulcers to accelerate wound healing.” However, this was rated as a weak recommendation based upon moderate-quality evidence.

**ASSOCIATION FOR THE ADVANCEMENT OF WOUND CARE**

The Association for the Advancement of Wound Care (AAWC) (2015) published a guideline on care of pressure ulcers.\(^{[28]}\) Electrical stimulation was included as a potential second-line intervention if first-line treatments did not result in wound healing. However, the group noted that electrical stimulation was not compared in a RCT to standard dressing treatment for wounds. The guideline did not address electromagnetic therapy.

**NATIONAL INSTITUTE FOR HEALTHCARE EXCELLENCE**

Diabetic foot problems: prevention and management

The National Institute for Healthcare Excellence (NICE) published a guidance stating do not offer electrical stimulation for diabetic foot ulcers unless part of a clinical trial.\(^{[29]}\)

Pressure Ulcer: prevention and management

NICE published a guidance stating do not use electrotherapy to treat pressure ulcers in adults unless in a clinical trial.\(^{[30]}\)

**WOUND HEALING SOCIETY**

Gould (2016) published updated 2015 guidelines for pressure ulcers.\(^{[31]}\) The guidelines state that electrical stimulation may provide healing for pressure ulcers that fail conservative treatments. It is not known what types of electrical stimulation will provide benefit, nor has it been determined which wounds are most likely to respond.

**SUMMARY**

There is not enough research to show that electrical stimulation or electromagnetic therapy for the treatment of wounds improves health outcomes. No clinical guidelines based on research recommend electrical stimulation or electromagnetic therapy for wound treatment.
Therefore, the use of either electrostimulation or electromagnetic therapy is considered investigational for the treatment of wounds.

**REFERENCES**


### CODES

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*Date of Origin: February 2004*