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## RESEARCH ARTICLE

### EFFECT OF HIGH VOLTAGE STIMULATION ON PRESSURE ULCERS HEALING: (SYSTEMATIC REVIEW)

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#### ABSTRACT

**Background:** The use of High voltage stimulation in patients with pressure ulcers is very important, and thus the scientific evidence for its effectiveness needs to be evaluated through a systematic review. **Objective:** To provide updated evidence-based guidance for High voltage stimulation effects on the healing of pressure ulcers. **Data sources:** Pub Med (Medline), Ovid, Physiotherapy Evidence Database (Pedro), Google scholar website, Cochrane Central Register of Controlled Trials, Electron library of Cairo University, Science direct website were searched from their earliest records up to December. **Data extraction:** Template was created to systematically code the demographic, methodological, and miscellaneous variables of each RCT. The Physiotherapy Evidence Database (Pedro) scale was used to evaluate the study quality. **Data synthesis:** Five studies included 200 participants in total. Best evidence synthesis was applied to summarize the outcomes, which were wound Surface Area (WSA), Wound tracing measures, Planimetry of Congruent. **Conclusions:** The current level of evidence to support the effectiveness of electric stimulation (High voltage stimulation) on pressure ulcers healing is strong. As according to this review there is support enough to use electric stimulation (High voltage stimulation) in treatment of pressure ulcers to reduce wound surface area (WSA) in different stages of pressure ulcers and accelerate their healing and decrease the mortality rate of a patient with pressure ulcers.

#### INTRODUCTION

A systematic review (SR) is literature reviews that focus on a single question that tries to identify, appraise, select and synthesize all high-quality research evidence relevant to that question. Systematic reviews of high-quality evidence across all type of study are crucial to evidence-based medicine. An understanding of systematic reviews and how to implement them in practice is becoming mandatory for all professionals involved in the delivery of health care. Systematic reviews are not limited to medicine but are quite common in other sciences (Dicenso *et al.*, 2009). A systematic review uses an objective and transparent approach for research synthesis, with the aim of minimizing bias. While many systematic reviews are based on an explicit quantitative meta-analysis of available data, there are also qualitative reviews which adhere to the standards for gathering, analyzing and reporting evidence. The EPPI Center has been influential in developing methods for combining both qualitative and quantitative research in systematic reviews (Thomas, 2004). A pressure ulcer is defined as maceration of the skin and deeper tissues due to unrelieved pressure, shear forces, and /or frictional forces (Crenshaw, 1989).

Bedsore also called pressure sores or pressure ulcers are injuries to skin and Pressure ulcers are often undertreated. A pressure ulcer is a break in the integument usually caused by continuous pressure to skin and muscle. Although these ulcers can occur anywhere on the body, they are often located in the trochanteric, ischial, heel, and sacral areas. Patients may not immediately be aware of these developing wounds. Because they often occur in bed-bound, paralyzed, and elderly patients undergoing treatment for other diseases. The prevalence of pressure ulcers in the United States is estimated to be 1.3 million to 3 million. The incidence of pressure ulcers is estimated to be 5% to 10% among hospitalized patients (Barrois, 1995). Nearly 700,000 people are affected by pressure ulcers each year, across all care settings, including patients in their own homes, with the most vulnerable of patients aged over 75. Around 186,617 patients develop a pressure ulcer in the hospital each year, and each pressure ulcer adds over £4,000 in additional costs to care (Michelle, 2014). Pressure ulcers develop as a result of a combination of physiologic events and external conditions. The classic thinking of tissue ischemia induced by prolonged external pressure on the tissue being the sole causative factor of pressure ulcer formation has been examined more systematically. Along with localized ischemia and reperfusion injury to tissues, impaired lymphatic drainage has been shown to contribute to injury as well. Compression prevents lymph

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fluid drainage, which causes increased interstitial fluid and waste build up and contributes to pressure ulcer development. Deformation of tissues has been shown to be a greater indicator of pressure ulcer formation than the pressure exerted on tissues alone (Coleman, 2014). The spinal cord injury patient population is at the highest risk (25–66%) of developing a pressure ulcer due to the combination of immobility and decreased sensation. A prospective study of spinal cord patients not only found that sacral and ischial pressure ulcers were very common (43% and 15%, respectively), as might be expected but also noted that the second most common location was on the heel (19%) (Kruger, 2013 and Verschuere, 2011). Pressure ulcer formation is highly influenced by risk factors (Table I), including all conditions leading to immobility, decreased or lack of sensation, as well as malnutrition (Health Quality, 2009).

**Table 1. Intrinsic and extrinsic factors influencing the development of pressure ulcers**

Intrinsic risk factors for the development of pressure ulcers	
•	Diabetes
•	Smoking
•	Malnutrition
•	Immunosuppression
•	Vascular disease
•	Spinal cord injury
•	Contractures
•	Prolonged immobility
Extrinsic risk factors for the development of pressure ulcers	
•	Lying on hard surfaces
•	Nursing homes
•	Poorly fitted prostheses
•	Poor skin hygiene
•	Patient restraints

**Collagen synthesis.** ES of fibroblasts improves collagen synthesis (Bourguignon, 1987). Muscle and nerve conductivity and intercellular communication are enabled by bioelectric processes. An electric current necessary for a live cell to function flows because of the gradient of ion concentration in the cells and their different electric potentials (Weiss *et al.*, 1990 and Lampe, 1998). The recent recommendation that ES be considered in the management of recalcitrant Stage II, Stage III, and Stage IV pressure ulcers is based, in part, on a meta-analysis (Gardner *et al.*, 1999). While the mechanisms that explain how ES promotes wound healing are poorly understood, some believe that ES imitates the natural electrical current that occurs in the skin when it is injured (Gardner, 1999). It has been shown that ES induces cellular actions in almost every phase of the wound healing cascade, including the stimulation of several fibroblast activities, such as enhanced collagen and deoxyribonucleic acid synthesis, adenosine triphosphate production and calcium influx, and an increased number of growth factor receptor sites (Houghton, 2010). In vitro studies on macrophages, epithelial cells, and fibroblasts have demonstrated that ES promotes the migration and activation of key cells within the wound site. Additionally, in vivo studies involving animal models have shown that ES results in more collagen deposition, enhanced angiogenesis, greater wound tensile strength, and a faster wound contraction rate (Houghton, 2010).

## Subjects, instrumentations, and methods

### Subjects:

**Search strategy:** This review included studies that examined the effect of high voltage stimulation on the healing of pressure ulcers. Literature search was performed independently by the five authors using an electronic inclusive literature search of Pub Med (Medline), Ovid, Physiotherapy Evidence Database (Pedro), Google scholar website, Cochrane Central Register of Controlled Trials, Electron library of Cairo University, Science direct website databases from their earliest records to December 2018, using a number of keywords: High voltage stimulation-pressure ulcers – wound healing – Electric stimulation – HVPC. These keywords were used individually and/or were combined. All references from the selected articles were also cross-checked by the authors to identify relevant studies that may have been missed in the search. The reviewers also used the Science Citation Index (Science Direct) to conduct forward citation tracking of any eligible studies found, in order to identify additional articles relevant for the review.

**Study selection:** The titles and abstracts collected by the above-mentioned search strategy were initially screened against the inclusion and exclusion criteria for identification of the relevant trials. When the title and abstract did not indicate clearly if an article should be included, the complete article would be read to determine its suitability.

**Eligibility criteria:** The inclusion criteria for studies to be included in this systematic review were as follows: Published English studies with full-text articles of Randomized controlled trials (RCTs) that were showing the effect of high voltage stimulation on the healing of pressure ulcers. Types of Participants: the review included Participants of all ages. Types of Interventions: This review included studies which demonstrated the effects of applying high voltage stimulation and its effect on the healing of pressure ulcers. Types of Outcome Measures: Systematic review of the effect of high voltage current on decreasing wound surface area in patients with pressure ulcers. Primary outcomes: wound surface area. Secondary outcomes: Wound tracing measure. Studies were excluded if the research was unpublished studies, Study design other than RCT (e.g. case report, controlled trials, cohort study), Studies that measured outcomes not related to the scope of our study,

Not related articles and Studies published in a language other than English.

**Data-extraction and management:** Data from all the included studies were summarized in the following format that includes: participants' characteristics (number in each group, target population, diagnosis, numbers in each diagnostic subgroup, and ages), intervention used, control used, research design and level of evidence for the study, and outcomes of interest. Key details of each study were extracted using the specific data extraction format. The format includes Study design, The characteristics of participants, The characteristics of interventions including types of current, intensity, duration, number of session per week, total duration (wks) and any additional care, Details of outcome measures and risk of bias including randomization, blinding, attrition, and reporting.

**Assessment of methodological quality:** The review authors independently assessed the risk of bias of included studies, based on the Cochrane Handbook for Systematic Reviews of Interventions (Higgins and Green, 2008). All the included

studies were scored on their methodological rigor with the Physiotherapy Evidence Database (Pedro) scale (Pedro, 2010).

## Appendix.

The PEDro scale examines 11 aspects of the quality of methodology. The Pedro scale considers two aspects of trial quality, namely the "believability" (or "internal validity") of the trial and whether the trial contains sufficient statistical information to make it interpretable. It does not rate the "meaningfulness" (or "generalisability" or "external validity") of the trial, or the size of the treatment effect. The scale is used to rate studies from 0–11 according to following 11 methodological criteria: specified eligibility criteria, random allocation, concealed allocation, baseline comparability, blinded subjects, blinded therapists, blinded assessors, adequate follow-up, and intention-to-treat analysis, between-group comparisons, and point estimates and variability. Each item was scored as 1(yes) or 0(no). The studies were ranked as 'high quality' if their score is more than or equal 7, studies with a score of 5 or 6 were considered of 'moderate quality' and those with a score of 4 or less were deemed of 'poor quality' PEDro scores were not used as inclusion/exclusion criteria, but rather as a basis for data analysis and to discuss the strengths and weaknesses of studies. The first item on the Pedro scale (the item on eligibility criteria) is related to external validity, so it does not reflect the dimensions of quality assessed by the Pedro scale. This item is not used to calculate the method score (which is why the 11 item scale gives a score out of 10). According to the Pedro guidelines, a positive answer to each of the criteria 2 to 11 will yield one point, obtaining a Pedro score of 0 to 10.

The PEDRO scale has been shown to have moderate interrater reliability (intraclass coefficient for the total score is 0.56, 95% confidence interval 0.47–0.65), (Maher, 2003). Papers that had a Pedro score of seven or higher would be considered 'high quality', those with a Pedro score of five or six would be considered 'moderate quality', and those with a Pedro score of four or less would be considered 'poor quality'. The more the number of scores of the aspects evaluating the quality of the study, the more quality of the study (Moseley, 2002).

**Data synthesis and analysis:** After extracting data from each study included in the systematic review, data were compared and the findings were represented either quantitatively, qualitatively or both according to the homogeneity between studies. Meta-analysis is a quantitative method employing statistical techniques, to combine and summarize the results of studies that address the same question without major differences in its inclusion or exclusion criteria of the participants, mode of administration, doses, and duration of the intervention as well as the comparison intervention, and the outcomes assessed and the methods of their assessment. Studies were clinically, methodologically and statistically homogenous before combining its results. So, Meta-analysis was done to five studies as they are homogenous and descriptive analysis was done to two studies as they are heterogeneous. Confidence interval (CI) is defined as "the range of scores within which the true score for a variable is estimated to lie within a specified probability (e.g: 90 percent. 95 percent.99 percent)" (Jewell, 2008). Effect sizes with 95% CIs were calculated if raw data were available in the studies. The effect sizes give an easy understanding of how big the treatment effect is and the clinical significance of these

statistically. Significant treatment effects can also be justified. The effect size was "the difference between the means of outcome measures of the participants and control group". If there was no control group, the difference between the pre and post-treatment means would be used as the participants were acting as their own controls. If heterogeneity is present, results of the studies will not be applicable to be combined but will be summarized as descriptive analysis (Verschueren, 2011).

## RESULTS

**The flow of studies through the review:** Only five studies met the inclusion criteria. Randomized controlled trials were made on the topic.

**Table 2. The five selected studies for this systematic review**

Study	Title
Anna Polak <i>et al.</i> , (2016)	Evaluation of the Healing Progress of Pressure Ulcers treated with Cathodal High-Voltage Monophasic Pulsed Current: Results of a prospective, double-blind randomized controlled trial.
Andrzej Franek <i>et al.</i> , (2011)	Effect of High Voltage Monophasic Stimulation on Pressure Ulcer Healing: Results From a Randomized Controlled Trial.
Ahmad ET (2008)	High voltage pulsed galvanic stimulation: effect of treatment duration on the healing of chronic pressure ulcers.
Griffin JW <i>et al.</i> , (1991)	Efficacy of high voltage pulsed current for healing of pressure ulcers in patients with spinal cord injury.
Luther C. Kloth and Jeffrey A. Feedar (1988)	Acceleration of Wound Healing with High Voltage, Monophasic, Pulsed Current.

The main reasons for exclusion of the other studies were: The other study doesn't meet the inclusion criteria. They did not meet the inclusion and exclusion criteria. The other studies not randomized control trials. They were non-intervention studies. They were narrative reviews.

**Description of Studies:** The data extracted from the 5 studies are summarized in Table (3). There were 200 participants in the 5 studies. They have pressure ulcers with different stages in all ages.

**Methodological Quality and level of evidence:** The mean PEDro score of all studies was (range 3-10) Table (4). (2 studies with scores 10, one study with score 3, one study with score 5 and last one study with score 7), indicating that the quality of the RCTs included in this research was high to moderate. All studies were randomized; 100% group similarity at baseline and point estimate and variability except one study. 66% of studies did not perform blinding of participant and therapist (66%), concealed allocation (20%), and blinding of assessor (66%), between-group statistical analysis for at least one key outcome (40%) didn't perform. The scoring of each study with the Physiotherapy Evidence Database (PEDro) scale is listed in Table 4. The scores of all studies included in the study range from 3 to 10, the more the number of scores of the aspects evaluating the quality of the study, the more quality of the study.

**Interventions:** The intervention method, dose, duration, and intensity varied across the studies. One study used Cathodal HVMPD 154 microseconds 100 pulse/second 0.24A, 250  $\mu$ . applied continuously for 50 min once a day, 5 times a week (Moseley A M *et al.*, 2002), second study used high voltage mono-phasic stimulation

Table 3. Data extraction sheet

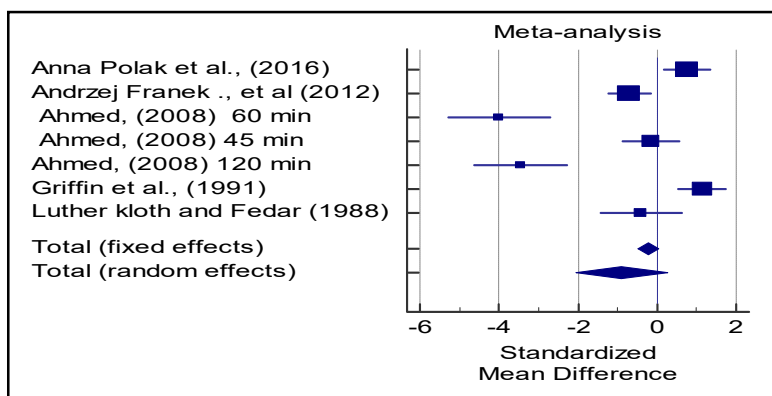
Study	Study design	Population	Age Range (X—)	Eligibility criteria	Intervention	Outcomes	Results
Anna Polak <i>et al.</i> , 2016	RCT	49 patients with WSA with different sizes	Age range 60-95 Mean age 79.92±8.50 years at ESgroup and 76.33±12.74 years at the control group	Patients with stage II and stage III pressure ulcers	Cathodal HVMP 154 microseconds 100 pulse/second 0.24A, 250 μ applied continuously for 50 min once a day, 5 times/week	-wound surface area (WSA) -percentage of PrUs in which WSA closed or increased which calculated after 6 weeks -PAR	7 measurements were taken to establish each patient's (WSA) in cm <sup>2</sup> For all PrUs that closed before the end of week 6, the data of closure was recorded the wound was defined as closed when its surface decreased to 0 cm <sup>2</sup> The contours of wounds were transferred onto transparent film they measured with planimeter to established WSA the data were processed by a digitizer
Andrzej Franek <i>et al.</i> , 2011	RCT	58 patients with different pressure ulcers sizes	Age range from 14 -88 years 40-50 years Mean age= 42	Patients with pressure ulcers grade II and grade III	High voltage mono-phasic stimulation 100 microseconds 50 min once daily 5 days /week use cathode for 2 weeks followed by anode for 4 weeks	-measuring the wound area that included nonviable and granulation tissue by planimetry of congruent projections of these wounds onto transparency paper, using a digitizing pallet. The depth of the ulceration was measured at various points by precision micrometry. Later, noticeable results were transferred to the software. The electronic equipment for the measurement of areas and volumes of the ulcers consisted of a digitizer. -WSA (Wound surface area)	the wound healing progressed steadily; however, the process was more steady and significant in patients treated with electrical stimulation
Ahmad ET (2008)	RCT	60 Patients with an indolent pressure ulcer of grade II (Yarkony-Kirk) classification	Age range 30-50 years Mean age 38.40 to 39.40	Patients with an indolent pressure ulcer of grade II (Yarkony-Kirk classification)	HVPS for 60 min and 45 min and 120 min /7 days a week use cathode for first 3 days then use anode electrode	-WSA (Wound surface area)	(WSA) was measured by tracing the wound perimeter WSA measurements were taken at zero time ("pre"), week 3 ("post I"), and week 5 ("post II").
Griffin JW <i>et al.</i> (1991)	RCT	17 patients have SCI with PrUs at different locations	17-74	Patients with SCI of complete or incomplete SCI, and have a pelvic pressure ulcer (over either the sacral coccygeal or gluteal regions)	Electric stimulation device mono-phasic 30 min pulsed 128 pulses/sec 2 times /day for 4 weeks	-WSA (Wound surface area)	High voltage pulsed galvanic current for 60-120 min seven days a week is the optimal duration for the enhancement of chronic dermal ulcer healing
Luther C. Kloth and Jeffrey A. Feedar., 1988	RCT	16 Patients	age range from 20 to 89 years	Patients with stage IV decubitus ulcers	Apply (ESTR) for 45 min once a day five days a week use twin pulsed current freq 105 Hz and intraphase an interval of 50 μsec	-Wound surface area(WSA) Wound tracing transposed onto metric graph paper from plastic wrap tracing measure wound area participants.	HVS effectively augment tissue repair and reduce treatment cost

RCT- randomized control trial. PrUs-Pressure ulcers SCI-Spinal cord injury ESTR-Electric stimulation for tissue repair

Table 4. PEDro scores and level of evidence for included studies (n=5)

Criteria	Anna Polak ., et al (2016)	Andrzej Franek ., et al (2011)	Ahmed E.T (2008)	Griffin JW., et al (1991)	Luther C. Kloth and Jeffrey A. Feddar (1988).
1-Specified eligibility criteria	Yes	Yes	Yes	Yes	Yes
2-Random allocation of participants	Yes	Yes	Yes	Yes	Yes
3-Concealed allocation	Yes	Yes	Yes	No	Yes
4-Similar prognosis at baseline	Yes	Yes	Yes	Yes	Yes
5-Blinded participant	Yes	No	Yes	No	No
6-Blinded therapists	Yes	No	Yes	No	No
7-Blinded assessors	Yes	No	Yes	No	No
8-More than 85% follow-up for at least one key outcome	Yes	No	Yes	No	Yes
9-'Intention to treat' analysis	Yes	Yes	Yes	Yes	Yes
10-Between-group statistical analysis for at least one key outcome	Yes	No	Yes	No	Yes
11-Point estimates of variability for at least one key outcome	Yes	Yes	Yes	No	Yes
PEDro score	10/10	5/10	10/10	3/10	7/10

The meta-analysis (forest plot):



Study	N1	N2	Total	SMD	SE	95% CI	t	P	Weight (%)	
									Fixed	Random
Anna Polak et al., (2016)	25	24	49	0.748	0.291	0.162 to 1.334			21.58	14.90
Andrzej Franek ., et al., (2012)	29	29	58	-0.696	0.267	-1.231 to -0.162			25.66	14.99
Ahmed, (2008) 60 min	15	15	30	-3.998	0.627	-5.282 to -2.715			4.66	13.13
Ahmed, (2008) 45 min	15	15	30	-0.160	0.356	-0.889 to 0.569			14.45	14.63
Ahmed, (2008) 120 min	15	15	30	-3.456	0.570	-4.624 to -2.288			5.62	13.48
Griffin et al., (1991)	24	26	50	1.149	0.301	0.543 to 1.755			20.14	14.86
Luther kloth and Fedar (1988)	9	7	16	-0.408	0.482	-1.442 to 0.625			7.88	14.00
Total (fixed effects)	132	131	263	-0.222	0.135	-0.488 to 0.0444	-1.641	0.102	100.00	100.00
Total (random effects)	132	131	263	-0.894	0.583	-2.041 to 0.253	-1.534	0.126	100.00	100.00

Test for heterogeneity

Q	103.5942
DF	6
Significance level	P < 0.0001
I <sup>2</sup> (inconsistency)	94.21%
95% CI for I <sup>2</sup>	90.41 to 96.50

100 microsecond 50 min once daily 5days /week use cathode for 2 weeks followed by anode for 4 weeks (Franek, 2011), third study used HVPC for 60 min and 45 min and 120 min 7 times a week use cathode for the first 3 days then use anode electrode (Ahmad, 2008), fourth study used Electric stimulation device mono-phasic 30 min pulsed 128 pulses/sec 2 times per day for 4 weeks (Griffin, 1991) and the fifth study used high voltage, mono-phasic twin-pulsed generator 45 minutes applied to ulcer site one time a day 5 days per week (Kloth, 1988).

**Outcome Measures:** Studies also differed in the type of outcome measures first study used wound surface area (WSA) measured with planimeter contour of wounds were transferred

onto transparent film (Polak, 2016), second study used measuring the wound area that included nonviable and granulation tissue by planimetry of congruent projections of these wounds onto transparency paper, using a digitizing pallet (Franek, 2011), the third study used The wound surface area (WSA) was measured by tracing the wound perimeter (Ahmad, 2008) the fourth study used wound surface area (WSA) Wound length width in square centimeter (Griffin, 1991) and the fifth study used Wound tracing transposed onto metric graph paper from plastic wrap tracing measure wound area participants (Kloth, 1988).

**Effect of high voltage stimulation:** (Anna Polak et al.,2016) found that HVMPC accelerates the healing of stage II and III

Pressure ulcers decrease WSA fastest during the first 4 weeks, in 5<sup>th</sup> and 6<sup>th</sup> weeks decrease surface area pressure ulcers slower rate. (Andrzej Franek *et al.*, 2011) found Granulation is also promoted by cathode stimulation, which attracts positively charged fibroblasts. When the wound base is filled with the granulation tissue, anode stimulation is applied, which facilitates the migration of negatively charged epidermal cells. (Ahmad ET (2008)(22) found convincing evidence exists that the electrically augmented healing of a delayed ulcer is best facilitated by HVPC stimulation for 60 minutes seven days per week. (Griffin JW *et al.*, 1991) ulcers treated with HVPC demonstrated a significantly greater percentage of decrease from their original size after the 5th, 15th, and 20th days of treatment than did placebo ulcers. The clinical implications of this study are that HVPC can be a significant adjunct to good medical care in promoting healing of pelvic ulcers in patients with SCI. (Luther C. Kloth and Jeffrey A. Feedar 1988) (Thomas *et al.*, 2004) A mean healing rate of 44.8% a week and the total healing of chronic wounds of patients in the Treatment Group were achieved using anodal HVS. The results indicate that ESTR from a HVS source effectively augments tissue repair and reduces the treatment costs of stage IV chronic dermal ulcers.

## DISCUSSION

The purpose of the current review was to evaluate the effectiveness of high voltage current stimulation in patients with pressure ulcers, this review includes studies published from 1988 up to 2016 and searched on Medline database through Pub Med, PEDro, Physiotherapy Evidence Database, Cochrane library also was searched and Google web site. This systematic review analyzed five randomized controlled trials, by applying strict selection criteria for inclusion, only full-text articles of randomized controlled trials were included all trials met at least three criteria on the PEDro scale. With high voltage, stimulation is probably beneficial for the healing of different stages of pressure ulcers. The main objective of this review was to critically evaluate articles that demonstrate this assumption. As we selected only the randomized trials to meet the highest standard of evidence, a stiff conclusion cannot be achieved through this review with five studies. Furthermore, there was large clinical heterogeneity presented across the studies. Combining all outcome measures of all studies, applying high voltage stimulation current on pressure ulcers generally demonstrated strong effects in decreasing wound surface area, increases healing rate, comprising decreases mortality rate of pressure ulcer patients, decrease hospitalization time for bed recumbence patients. Electric stimulation (ES) induced improvement in wound healing depends on the type of ES waveform and the particular methodology used, but the optimal parameters of stimulus and the ES schedule for chronic wounds still need to be defined. The parameters of HVMPD used in all cited studies were similar. The authors reported using twin-peak monophasic Pulses with a pulse duration of 100 microseconds or 50 microseconds and pulse frequency of typically 100 pulses per second (PPS) or 105 pps, at which the current evoked only sub motor sensory perception. Electric stimulation involving HVMPD was usually applied for a total of 3.75 to 7 hours a week. In most cases treatment sessions of 45 to 60 minutes, we held daily, 5 to 7 days a week. Both electrodes were placed on conductive saline, moist gauze or on a wafer hydrogel dressing. The treatment electrode was placed on the wound surface and the return electrode was attached to healthy skin at least 15 to

20 cm away. In some cases, treatment started with cathodal stimulation that was continued over the whole length of the trial or was applied at the initial stage only. Evidence-based medicine is needed to improve the quality of health care. A body of evidence regarding safety, effectiveness, appropriate indications, cost-effectiveness, and other attributes of medical care are demanded (Verschueren JH, 2011).

## Conclusion

Available data from five reviewed studies demonstrated the efficacy of the electric stimulation (High voltage stimulation) on pressure ulcers healing is strong. As according to this review there is support enough to use electric stimulation (High voltage stimulation) in treatment of pressure ulcers to reduce wound surface area (WSA) in different stages of pressure ulcers and accelerate their healing.

## Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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