Etroestimulação Aplicada à Cicatrização de Feridas Cutâneas: Revisão Integrativa

Electrotherapy Applied to Skin Wound Healing: Integrative Review

Electroterapia Aplicada a la Cicatrizacón de Heridas Cutâneas: Revisión Integradora

RESUMO

Objetivo: Identificar os tipos de eletroestimulação (EE) descritos na literatura para o tratamento de feridas cutâneas. **Método:** Revisão integrativa da literatura nas bases de dados eletrônicos: Scielo, LILACS, MEDLINE via PubMed Central de Janeiro 2017 a dezembro 2025. Foi utilizado como estratégia de busca a ferramenta PICO para artigos redigidos em português, inglês e espanhol. Foram incluídos artigos originais com texto completo alinhados ao objeto da pesquisa. **Resultados:** Foram selecionados 05 artigos. A maioria dos estudos demonstrou cicatrização acelerada de feridas com o uso de eletroestimulação em comparação com a terapia padrão e placebo. Existem diversas modalidades de EE disponíveis e utilizadas com sucesso para a cicatrização de feridas; no entanto, o número de estudos tem variação em quantidade e qualidade entre diferentes modos de aplicação. **Conclusão:** a eletroestimulação demonstra grande potencial terapêutico ao estimular os processos de cicatrização em vários tipos de feridas. Entretanto, o efeito da EE ainda não está claro. São necessários mais estudos, nos quais as evidências cientificas possam definir os fatores que potencializam a eficácia da EE.

DESCRITORES: Ferimentos e lesões; Cicatrização de Feridas; Terapia de Estimulação elétrica.

ABSTRACT

Objective: To identify the types of electrical stimulation (ES) described in the literature for the treatment of cutaneous wounds. **Method:** An integrative literature review was conducted using the electronic databases SciELO, LILACS, and MEDLINE (via PubMed Central) for the period from January 2017 to December 2025. The PICO framework was used as the search strategy for articles written in Portuguese, English, and Spanish. Original full-text articles relevant to the research topic were included. **Results:** Five articles were selected. Most studies demonstrated accelerated wound healing with the use of electrical stimulation compared to standard therapy and placebo. Various ES modalities are available and successfully used for wound healing; however, the number of studies varies in quantity and quality across different application modes. **Conclusion:** Electrical stimulation demonstrates significant therapeutic potential by stimulating healing processes in various types of wounds. However, the specific effects of ES remain unclear. Further studies are needed to provide scientific evidence defining the factors that enhance the efficacy of ES.

DESCRIPTORS: Wounds and injuries; Wound healing; Electrical stimulation therapy.

RESUMEN

Objetivo: Identificar los tipos de electroestimulación (EE) descritos en la literatura para el tratamiento de heridas cutáneas. **Método:** Revisión bibliográfica integradora en las bases de datos electrónicas: Scielo, LILACS, MEDLINE vía PubMed Central desde enero de 2017 hasta diciembre de 2025. Se utilizó la herramienta PICO como estrategia de búsqueda para artículos escritos en portugués, inglés y español. Se incluyeron artículos originales con texto completo alineado con el objetivo de la investigación. **Resultados:** Se seleccionaron cinco artículos. La mayoría de los estudios demostraron una cicatrización acelerada de las heridas con el uso de electroestimulación en comparación con la terapia estándar y el placebo. Existen varias modalidades de EE disponibles y utilizadas con éxito para la cicatrización de heridas; sin embargo, el número de estudios varía en cantidad y calidad entre los diferentes métodos de aplicación. **Conclusión:** La electroestimulación demuestra un gran potencial terapéutico para estimular los procesos de cicatrización en diversos tipos de heridas. Sin embargo, el efecto de la EE aún no está claro. Se necesitan más estudios, en los que la evidencia científica pueda definir los factores que mejoran la efectividad de la estimulación eléctrica.

DESCRIPTORES: Heridas y lesiones; Cicatrización de heridas; Terapia de estimulación eléctrica.

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INTRODUÇÃO

As feridas que não avançam no processo normal de cicatrização e permanecem abertas por mais de um mês são classificadas como feridas crônicas[1]. Quando não cicatrizam a longo prazo, podem comprometer a qualidade de vida e acarretar custos significativos. Uma estimativa de gastos com feridas em diversos países apontou, em 2019, que os Estados Unidos da América tiveram uma despesa de $ 126,8646, enquanto que o Brasil, na 8ª posição, teve um gasto estimado de $ 6,4386[2]. Estes dados retratam o fardo econômico enfrentado por várias nações ao redor do mundo.

Uma das principais etiologias para o desenvolvimento de feridas crônicas é o Diabetes mellitus. O diabetes mellitus é uma doença metabólica caracterizada por hiperglicemia[3] e, quando somada à obesidade, faz com que os indivíduos portadores apresentem maior risco para o surgimento desse tipo de ferida. Entre as complicações do diabetes mellitus, destacam-se a neuropatia relacionada ao diabetes, a doença arterial periférica e as infecções, que favorecem o desenvolvimento de úlceras nos pés e nas pernas, comprometendo significativamente a qualidade de vida do paciente[4].

Contudo, além das lesões associadas ao diabetes, outras etiologias, como a lesão por pressão, a insuficiência venosa e a insuficiência arterial, também representam importante parcela das feridas crônicas e contribuem para a elevada demanda assistencial. Ademais, a maioria das pessoas que convivem com feridas abertas crônicas geralmente apresentam outras condições de saúde associadas, o que contribui para a complexidade do tratamento.

Diante desse cenário, o manejo adequado das feridas crônicas constitui um desafio e requer intervenções capazes de favorecer a cicatrização e prevenir complicações. Abordagens atuais no tratamento de feridas, na sua maioria, baseiam-se em curativos tradicionais que possam absorver o exsudado excessivo, manter umidade suficiente e fornecer uma barreira protetora contra o ambiente externo [6].

Alguns desses curativos são utilizados em feridas recobertas por necrose, na presença de osteomielite ou em feridas neoplásicas[7]. Para essas aplicações, envolve-se a incorporação de agentes terapêuticos, como anti-inflamatórios, antibióticos, compostos antibacterianos ou fatores angiogênicos, que são liberados diretamente no leito da ferida[8] com o objetivo de favorecer o processo de cicatrização. Embora esses recursos representem importantes avanços no manejo das feridas, os desafios relacionados à cicatrização, especialmente em feridas crônicas, têm impulsionado a investigação de terapias adjuvantes capazes de potencializar esse processo. Entre essas estratégias, destaca-se a eletroestimulação.

Eletroestimulação é uma aplicação exógena do campo elétrico para acelerar o processo de cicatrização de feridas, imitando a corrente natural de uma lesão[09]. A migração celular direcionada sob a influência de um campo elétrico natural é conhecida como galvanotaxis. Tendo em vista que as feridas crônicas têm uma corrente de ferida mais fraca que retarda a migração, proliferação e diferenciação celular[10], espera-se que a eletroestimulação restaure a corrente da lesão e acelere a recuperação da ferida.

Quando a integridade da pele é danificada, um campo elétrico endógeno será gerado na ferida e uma série de reações fisiológicas será iniciada para fechá-la [11]. O campo endógeno da ferida tem um efeito promotor em todas as fases da cicatrização. Em feridas que não cicatrizam sozinhas, a ação do referido campo pode auxiliar na estimulação e na manutenção das fases.

O tratamento pela eletroestimulação é considerado vantajoso pelo custo-efetivo e por apresentar poucas complicações; além disso, é considerado uma terapia adjuvante para acelerar a cicatrização de feridas agudas e crônicas, lesões por pressão e úlceras nos pés relacionadas ao diabetes [12].

Diversas formas de aplicação da EE na cicatrização de feridas cutâneas, tem sido amplamente exploradas, e a grande variação nos protocolos utilizados gera incertezas sobre a eficácia e o melhor protocolo aplicável no tratamento[13,14,15].

Apesar dos resultados promissores, diferentes modalidades de eletroestimulação têm sido empregadas na prática clínica e em estudos experimentais, utilizando distintos tipos de correntes e parâmetros de aplicação. Essa heterogeneidade dificulta a compreensão sobre quais estratégias apresentam maior potencial terapêutico para a cicatrização de feridas. Nesse contexto, esta revisão teve como objetivo analisar os tipos de eletroestimulação descritos na literatura para o tratamento de feridas cutâneas, fornecendo uma visão geral sobre os tipos de correntes aplicadas para melhor compreender a eficácia ao promover a cicatrização.

MÉTODOS

Trata-se de uma revisão integrativa da literatura, conduzida conforme estratégia metodológica de Mendes, Silveira e Galvão[25], que compreende as etapas: elaboração da pergunta norteadora da pesquisa, busca na literatura, coleta de

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dados, avaliação crítica dos estudos, análise e síntese dos resultados e apresentação da revisão.

Para execução do estudo a identificação do tema foi por meio do acrônimo PICO, onde elaborou-se a questão de pesquisa. Desta forma, classificou-se: P- Ferida; I- tipos de Eletroestimulação; C- Não aplicável; O- Cicatrização. Por meio desta estratégia emergiu a seguinte questão norteadora: Quais os tipos de eletroestimulação são utilizados no tratamento de feridas cutâneas?

A busca de dados foram levantados a partir das bases eletrônicas: Scientific Electronic Library Online (SCIELO), Biblioteca virtual de Saúde (BVS), na qual foram consultadas as bases de dados da Literatura Latino Americana e do Caribe em Ciências da Saúde (LILACS) e da Medical Literature Analysis and Retrievel System Online MEDLINE via PubMed utilizando os seguintes descritores: Ferimentos e lesões; Cicatrização de Feridas; Terapia por estimulação elétrica e seus correspondentes em inglês e espanhol, combinados por operadores booleanos (AND/OR).

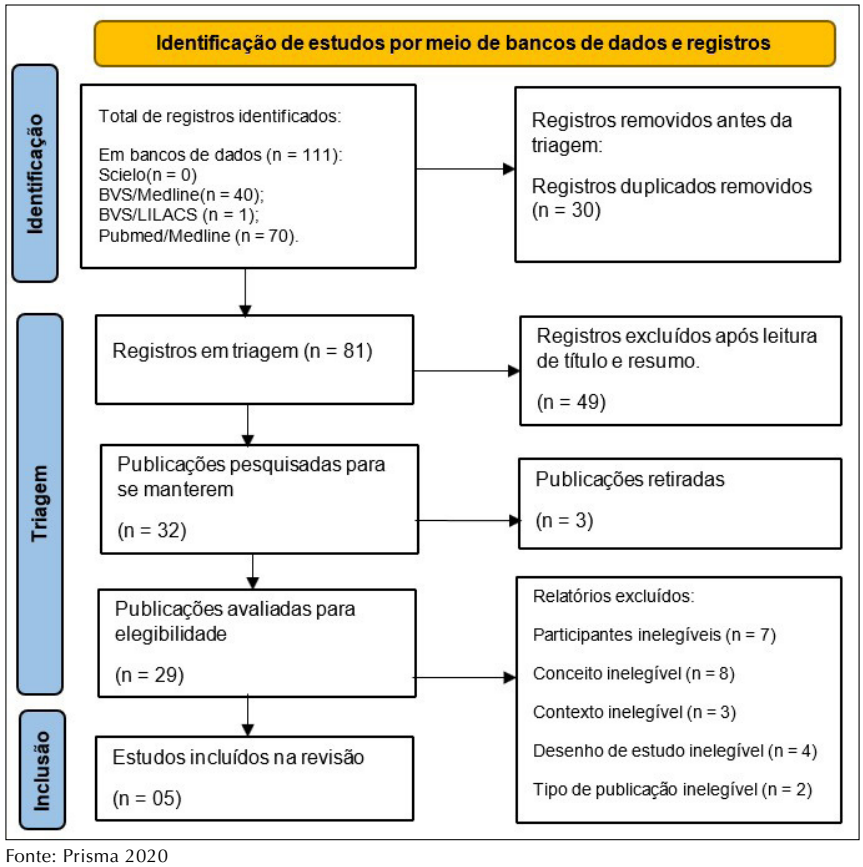
Nesta etapa refinou-se a busca ponderando os critérios de inclusão para seleção dos artigos: resumos disponíveis e alinhados ao objeto da pesquisa, artigos publicados em português, inglês e espanhol que abordassem a temática do uso da eletroestimulação no tratamento de feridas e que fossem disponíveis na integra e de forma gratuita obedecendo o Período de 01/01/2017 a 31/12/2025. Como critérios de exclusão, definiu-se: teses, dissertações, artigos não disponíveis para leitura na íntegra de forma gratuita e artigos duplicados.

A seleção dos estudos foi realizada por meio da leitura exploratória dos títulos e resumos, com a eliminação das duplicidades. As publicações elegíveis foram identificadas e selecionadas para a leitura integral dos textos completos. Por fim, os estudos selecionados foram submetidos à extração dos seguintes dados: autor/ano, título/desenho do estudo, tipo de ferida, tipo de eletroestimulação, objetivo do estudo e resultado. Os dados foram organizados em planilhas eletrônicas (Microsoft Excel) e posteriormente sistematizados em quadros para fins de análise e discussão.

A apresentação e a organização dos resultados da revisão integrativa foram conduzidas com base nas recomendações do Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[26] e o fluxograma foi utilizado para descrever de forma sistemática o processo de identificação, triagem, elegibilidade e inclusão dos estudos, assegurando transparência e rigor metodológico.

RESULTADOS

Neste ínterim, seguindo a definição dos descritores, a busca resultou em 111 artigos que após leitura dos títulos e resumos foram selecionados aqueles que expressavam alinhamento ao objeto da pesquisa sendo incluídos nesta revisão integrativa 05 artigos conforme fluxograma indicado na figura 1.



Fonte: Prisma 2020

O levantamento nas bases de dados resultou em cinco artigos selecionados para este estudo, cujos dados de catalogação podem ser observados na Tabela 1.

Sobre os artigos, pode-se inferir que eles possuem uma distribuição paritária quanto ao idioma da redação. No tocante ao desenho do estudo, observam-se três revisões sistemáticas com meta-análise, dois ensaios clínicos randomizados e controlados, sendo um duplo-cego. Dentro do recorte temporal estipulado, foi encontrado um trabalho em cada ano (2018, 2021, 2023) ao passo que dois em 2022. Com relação aos objetivos dos estudos e os tipos de

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feridas, observou se que, guardadas as peculiaridades de cada um, todos envolviam aspectos da eletroestimulação como tratamento de úlceras diabéticas, úlceras venosas, feridas, lesão por pressão, feridas crônicas e no pé diabético. Por fim, no que concerne aos resultados, houve predominância na redução das áreas de feridas e úlceras.

Tabela 1. Distribuição dos artigos por autor, ano, título e desenho de estudo, tipo de ferida, tipo de eletroestimulação, objetivo do estudo e resultado.

Autor/ano	Titulo/desenho do estudo	Wound Type	Type of Electrical Stimulation	Study Objective	Results
Zheng et al,2022,	Effect of electrical stimulation on patients with diabetes--related ulcers: a systematic review and meta-analysis	Diabetic ulcer	Pulsed current; Direct current	To understand the effectiveness of electrical stimulation (ES) in the treatment of patients with diabetes-related ulcers.	It was effective in reducing ulcer area and increasing healing rates, with 95% CI and P < 0.05.
Melotto et al,2022.	The effects of electrical stimulation on diabetic ulcers of foot and lower limb: A systematic review and meta--analysis.	Diabetic ulcer	Pulsed current and direct current	To analyze the results regarding the effects of ES used in combination with standard wound treatment (SWT) in the treatment of diabetic foot ulceration (DFU).	The results showed that the healing rate appears to be higher among diabetic ulcers treated with ES.
Rajendran et al,2021.	Electrical Stimulation to Enhance Wound Healing:A systematic review and meta--analysis	Acute wounds; Chronic wounds: diabetic, vascular, and pressure ulcers	Pulsed current; Direct current	To understand how electrical stimulation (ES) influences the cellular mechanisms involved in normal skin wound healing, its antibacterial effects, and the clinical efficacy of ES in accelerating chronic wound healing.	Findings indicate that ES, particularly pulsed current, may improve the healing of chronic wounds. Secondary outcomes, including wound perfusion and complete healing, were also positive after exposure.
Polak et al,2018.	A Randomized, Controlled Clinical Study to Assess the Effect of Anodal and Cathodal Electrical Stimulation on Periwound Skin Blood Flow and Pressure Ulcer Size Reduction in Persons with Neurological Injuries	Stage 2 to 4 pressure ulcers	Cathodal and anodal high-voltage monophasic pulsed current (HVPC)	To evaluate the effects of cathodal and anodal high-voltage monophasic pulsed current (HVPC) on perilesional skin blood flow (PSBF) and on reducing the size of Stage 2 to Stage 4 pressure ulcers.	Both ES modalities improved blood flow and the rate of wound area reduction.
Zulbaran-Rojas et al,2023,	Home-Based Electrical Stimulation to Accelerate Wound Healing-A Double-Blinded Randomized Control Trial.	Chronic diabetic foot ulcers	Interactive high-voltage pulsed alternating current (HVPAC)	To examine the efficacy of daily ES (E-Stim) in accelerating wound healing.	Initial data on efficacy after 4 weeks showed a 22% reduction in ulcer area.

Electrostimulation used as a treatment for skin wounds involves various current modes. Among the modes identified in studies are pulsed current (PC)—pulsed alternating current, in which electrons oscillate between the positive and negative poles of the involved tissues, both at high voltage—and direct current (DC). Another form of electrical stimulation (ES) involves the combination of these currents acting simultaneously.

In the comparative study of EE versus placebo or standard treatment (ST), conducted by ZHENG et al. (2022), which included randomized clinical trials (RCTs), the authors identified PC and DC—applied individually—as treatment modalities for diabetic ulcers over a period of 4 to 12 weeks. According to these authors, the currents increased tissue perfusion and stimulated angiogenesis, with no statistically significant differences between CP and CC in terms of healing and reduction in ulcer area. However, electrical stimulation with CP showed a potential benefit compared to CC.

A comparative study between a sham treatment and EE, conducted by RAJENDRAN et al. (2021)—which also involved randomized clinical trials (RCTs)—investigated the long-term effect of EE on wound healing mechanisms and its efficacy during wound treatment. The results demonstrated in in vivo experiments (chronic wounds) and in vitro that EE via PD and DC, when applied to diabetic ulcers, pressure ulcers, and vascular ulcers, increases blood perfusion in the wound, controls bacterial growth, enhances fibroblast migration, induces angiogenesis, and stimulates keratinocyte activity. Furthermore, the authors

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note that in most studies, high-voltage CP showed better healing outcomes compared to CC. However, in this same study, a meta-analysis of different EE modalities conducted by Khouri et al. (2017) indicated that CC was more effective in reducing the size of chronic wounds compared to CP.

In a comparative study between EE and standard wound care (SWC), conducted by MELOTTO et al. (2022) through a systematic review, EE was analyzed as applied to diabetic ulcers, with CC administered over a period of 4 to 16 weeks and CP over 8 to 12 weeks. These authors found that the healing rate appears to be higher in ulcers treated with EE than with STW. However, analyses of the effects of EE on ulcers yielded insufficient conclusions due to the high risk of bias and the data collected, which prevented the researchers from understanding the frequency of EE use and the duration of each application. Differences in methods among the articles made it difficult to compare the results, even though they are promising.

In the clinical, randomized, double-blind study by POLAK et al. (2018), conducted to evaluate EE using high-voltage monophasic pulsed current (CPMAV) applied to stage 2–4 pressure ulcers over a period of 4 to 8 weeks, blood flow and the rate of wound area reduction improved. However, the authors note that further studies are needed to determine the optimal treatment duration for achieving healing.

In the study by ZULBARAN-ROJAS et al. (2023), a randomized, double-blind clinical trial was conducted to evaluate high-voltage pulsed alternating current (HVPAC) applied to chronic diabetic foot ulcers over a 4-week period, an increase in perilesional tissue perfusion and a significant reduction in wound area were demonstrated, both of which are strong predictors of healing.

In general, most studies have demonstrated accelerated wound healing with the use of electrical stimulation (ES) compared to standard therapy and placebo. There are several modalities of ES available and successfully used for wound healing; however, the number of studies varies in quantity and quality across different modes of application[13] .

It is evident that electrical stimulation[14] is a potential tool for wound healing, acting directly on tissues to stimulate a healing response. Although it can induce various tissue responses that promote healing, it has not yet been established as an accepted treatment method [15] . Nevertheless, it shows promise in different treatment modalities that may lead to better outcomes[10] with fewer adverse effects[16] .

DISCUSSION

It has been known that electrical stimulation promotes the healing of wounds and ulcers since the 1960s[11] , when it demonstrated efficacy in reducing scarring in smallpox lesions. Since then, evidence has pointed to electrostimulation as a treatment for wounds of various etiologies, and its application has gradually expanded over time to include chronic and ischemic wounds as well as pressure injuries.[17] In the meantime, there has been growing interest in the use of this modality among medical companies and insurance providers.

Among the studies presented, most recognize the potential benefits of electrical stimulation as a complementary intervention for the treatment of acute and chronic wounds, with significant value in influencing the normal processes involved in wound healing[3,4,5,7,14] . Taken together, the results can be interpreted optimistically.

With regard to treatment modalities, CP and CC were mentioned in three studies as being more effective than conventional standard treatment[3,4,5] . In one of these studies, although the authors cited promising results, they did not present data to support an analysis of the effects of electrical stimulation (ES) on ulcers. [3] However, they suggest that future studies provide data on patient adherence to the electrical stimulation (ES) intervention and a description of non-healed diabetic ulcers using validated classifications. Regarding high-voltage pulsed current (HVPC), which was mentioned in two studies[7,14] , they highlight the positive therapeutic effect observed compared to the control group when applied to the wounds or to opposing edges, demonstrating significant improvement. These results may suggest greater efficacy of one current modality; however, it would be premature to recommend the use of one modality over another.

Although studies report increased cellular activity, improved peripheral tissue perfusion, and stimulation of angiogenesis—all of which are factors that promote healing—it should be noted that EE as a therapy still faces barriers[18] , attributed to the lack of cost-effectiveness analysis[19] and to the numerous electrostimulation devices available on the market, as they offer various configurations in terms of current type, duration, and application time[20] .

Despite the recognized effect of ES in reducing ulcer size and promoting healing, given the variety and modes of current application, there is no consensus on the effects and the optimal parameters to be used in ES.[21,22], a fact underscored by the heterogeneity of study designs and sample sizes, which hinders the comparison of results[4,14] . Indeed, the articles differ in design, intervention characteristics, EE modality, and wound size and severity[3,4,5,7,14,] . These differences may compromise the generalizability of

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the results. Consequently, varying parameters observed in the stimulation of different wounds result in distinct healing responses.

In the literature, EE is identified as an adjunctive therapy in wound treatment.[8,10,12,15,17,18] and the studies emerging from this research share results that are consistent with the literature. Overall, the studies showed that EE has the potential to promote healing and subsequently establish itself as an essential component in the arsenal of therapies used.

The use of EE in wounds caused by metabolic conditions, such as diabetic ulcers, vascular ulcers, chronic diabetic foot wounds, and diabetic foot ulcers, was mentioned in four studies[3,4,5,14], a finding that is consistent with the literature, which indicates that diabetic ulcers[12,13,22,27] and chronic wounds[10,19,21] are resistant to conventional treatments.

A systematic review and meta-analysis showed that electrostimulation provides a significant benefit compared to placebo or standard treatment in patients with diabetes-related ulcers. In this study, the mean standard deviation (MSD) was 2.79 (95% CI: 1.58–4.01), and the healing rate was 0.72 (95% CI: 0.54–0.96), referring to the percentage of the ulcer and the healing rate[3] . In contrast, a systematic review that included quantitative primary studies, such as randomized clinical trials (RCTs) and observational studies (both prospective cohort studies and retrospective studies), revealed inconclusive results regarding the use of electrical stimulation in the treatment of diabetic foot ulcers, which were related to the different treatment regimens found across the studies [4].

In this context, the literature reveals that electrical stimulation, when used in various treatment modalities, achieves percentage reductions in the surface area of acute and chronic wounds and diabetic foot ulcers, linked to increased healing rates[3,10,11,12,14,27] , contradicting the study cited as inconclusive.

In two studies[5,7] , ES was applied to pressure ulcers, where healing is generally a lengthy process and requires various treatment methods, which are often costly.[18]

In the studies, high-voltage pulsed current showed positive results regarding wound area and the healing process. In the first study[7], pressure ulcers (PUs) with initial sizes ranging from 1.01 cm² to 59.57 cm², most frequently located in the sacral region (73.77%) and classified as Stage 3 (62.29%), showed a statistically significant reduction in wound surface area ($P < 0.05$; P = 0.049).

The second study[5] evaluated the effects of electrical stimulation (ES) on different types of chronic wounds, including pressure ulcers; its results indicate that electrical stimulation (ES), particularly high-voltage pulsed current (HVPC), can improve the healing of chronic wounds with regular administration. Secondary outcomes, such as wound perfusion and complete healing, were also positive. Furthermore, pulsed current significantly reduces the size of chronic wounds when compared to control groups without ES.

In another study, however, a meta-analysis conducted by Arora et al. (2020) involving 20 RCTs showed similar findings. Although the authors classified the evidence as "moderate" (following the GRADE scale—Grading of Recommendations Assessment, Development, and Evaluation), in a sample of 561 participants (613 ulcers), electrical stimulation (ES) resulted in a higher (TRS) compared to sham ES ($p < 0.0001$).

Similar findings were identified in a study[18] that reviewed the literature on electrical stimulation for the treatment of stage II to IV pressure ulcers. Among the relevant results, it was highlighted that high-voltage ES over a period of 3 to 12 weeks achieved a 64% to 100% reduction in these ulcers, and the study recommended the use of this therapy.

In this regard, this recommendation aligns with the clinical guidelines published in 2019 and 2020 by experts[23,24] , which confirm that this therapy stimulates the proliferation and maturation processes of pressure ulcers. Furthermore, it cites high-voltage pulsed current as the most appropriate type of current for treatment, a finding consistent with that of the present study[5,7] , which demonstrated that the areas of Category II to IV pressure ulcers were reduced following the use of this current.

Decision-making by healthcare professionals is complex when it comes to treating wounds that are difficult to heal and do not respond to conventional dressings. This underscores the need to explore electrical stimulation as a complement to current wound treatment. A common yet complicated problem is that, in most cases, there is no consensus on the choice of treatment, requiring multidisciplinary approaches. The dilemmas stem primarily from long and arduous treatments, which is why the search for new methods that can improve wound healing without causing tissue damage is ongoing.

In this review, studies demonstrate that EE applied to acute or chronic wounds has the potential to stimulate healing by improving perfusion around the wound and reducing its size. In this context, the literature points to the possibility of using EE as an adjunctive physical therapy[6,8,11,15,16,20] . However, this review did not allow to conclude which EE is most effective due to the variation in currents and parameters used.

The present study has limitations, and the results may be affected by

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the small sample sizes and the heterogeneity of the study designs. Another limitation is that the variety of treatment protocols makes it difficult to determine an ideal parameter for a specific type of wound. These limitations need to be addressed in future studies should EE become a widely adopted treatment.

CONCLUSION

Electrical stimulation (ES) for wound treatment is not yet widely practiced, although its potential benefits are increasingly being demonstrated. Furthermore, it has notably gained prominence in the context of wound treatment. In this study, ES modalities emerged as treatment options by stimulating healing processes in patients with various types of wounds.

ES in this study was categorized into three types: direct current, pulsed current, and high-voltage alternating current. The pulsed and alternating current modalities, when used alone, offer the potential benefit of accelerating healing, showing better results when compared to direct current. The distinct effects of each current modality are not yet clear. Further studies are needed, in which scientific evidence can identify the factors that enhance the efficacy of EE.

Essentially, successful wound closure in a short period of time through a painless procedure is the fundamental principle in wound treatment. With an understanding of the mechanism of action and defined parameters of electrical stimulation and its benefits, it is believed that this therapeutic modality may accelerate wound healing and replace conventional dressings in the future, whether through electrical devices or smart dressings.

Finally, the study highlighted the use of electrical stimulation in wound treatment, especially for wounds affecting the lower limbs and pressure ulcers, while also demonstrating the therapeutic potential of this modality; however, a key limitation is the lack of standardized parameters. Furthermore, it revealed a scarcity of primary studies on the effects of electrostimulation in this context, pointing to gaps in scientific research.

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