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Electrical Stimulation in Patients with Difficult-Healing Lesions Secondary to Chronic Osteomyelitis: Cases Study

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ABSTRACT

Introduction: In patients with Chronic Osteomyelitis, the presence of injuries and complications associated with said entity is common, such as fistulous tracts, post-surgical wound dehiscence and ulcers. Conventional treatments used in exacerbation episodes within the clinical picture of the disease take weeks or months to compensate for the existing situation.

The study of three cases is presented, where the results of the combined application of electrical stimulation with conventional treatment promote this proposal as an alternative to achieve a more effective treatment in this type of patient.

Objective: To verify the effectiveness of the use of electrical stimulation, using the Stimul W® medical equipment, associated with conventional surgical treatment in patients with lesions that are difficult to heal secondary to chronic osteomyelitis.

Case Presentation: Three patients with Chronic Osteomyelitis were selected. In two of the patients there was an active fistulous tract and in the third, a predominance of the ulcerative process compared to the fistula.

Conclusion: In all cases, electrical stimulation caused the acceleration of the granulation tissue of the walls of the fistulous tract and the ulcerated area, finally achieving epitalization and closure of the lesions in ±30 days.

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Introduction

In certain situations, after a surgical intervention, wound dehiscence, or separation of the edges of the surgical incision, may occur due to the presence of infections or another type of adverse event, which does not allow closure of the wound by first intention [1,2]. Specialists affirm that a considerable part of wounds that do not heal are surgical [3]. Patients who suffer some type of bone fracture due to accidents or other causes sometimes undergo surgery and for certain reasons, after this process, the appearance of a dehiscent wound may occur, that is, part or the entire wound opens.

The conventional treatment of post-surgical wound dehiscence is fundamentally based on the use of analgesics, vitamin therapy (vitamin C), local dry dressings and antibiotic therapy in cases where necessary.

A wound due to dehiscence, receiving conventional treatment, can take, depending on the case and circumstances, from ***two months to two years*** and in the latter case, it runs the risk of becoming a wound that is difficult to heal, whose phases are defined as Coagulation, Inflammation, Proliferation and Maturation [4].

In the use of new techniques for the treatment of wounds due to dehiscence, different from conventional treatments, the use of Negative Pressure Therapies (NPT) stands out, although, according to Trujillo and collaborators. There is not enough scientific evidence to recommend TPN in the treatment of chronic wounds of different etiologies [5-7].

It is valid to point out that there are ***no known references to the application of electrical stimulation in the treatment of this type of wounds***.

There are certain orthopedic injuries or diseases that are treated surgically, which can eventually be complicated by wound dehiscence, which allows infection at the level of the skeletal system, leading to Chronic Osteomyelitis (infectious process at the level of bone tissue).

There are various surgical techniques used in the care of Chronic Osteomyelitis. The main highlights include curettage, debridement, Toillete (washing the septic area with chemical solutions) and packing with iodoformed gauze. Sometimes other techniques are used such as Masquelet, which is used in the treatment of bone defects of long bones [8,9].

Chronic Osteomyelitis in its active phase can lead to osteonecrosis of the affected area. However, frequently, other events occur such as the appearance of ulcers secondary to these surgeries and the presence of fistulas - as an accompanying element of the process - to expel accumulated debris and secretions. As reported in the scientific literature, these treatments for ulcers and fistulas can last from a minimum of six weeks to several years [10,11].

Since 1998, COMBIOMED Digital Medical Technology has designed and manufactured the Stimul W® Electrical Stimulator, intended for the prevention and acceleration of healing of wounds and ulcers of various etiologies. The equipment has been subjected to Clinical Trials, Field Tests and others. Techniques, with satisfactory results [12-15]. It has a Health Registry at the national level and in other countries, in addition to the patent and registered trademark..

The medical equipment meets international standards and the treatment is Non-Invasive, Non-painful. It has been used, with satisfactory results, in the treatment of injuries, such as pressure ulcers, venous ulcers and diabetic foot ulcers. It has also been used successfully in patients with fistulous processes of different etiologies to accelerate their closure or healing.

The search for a new alternative that could complement conventional treatments led to the implementation of a case study to determine the effectiveness of the combined use of these conventional therapies and electrical stimulation in the healing of ulcers and closure of fistulous tracts in patients with Osteomyelitis Chronicle.

Discussion

A case study was designed to evaluate the effectiveness of the combined use of conventional treatment and electrical stimulation in difficult-to-heal lesions associated with patients with Chronic Osteomyelitis (ulcers, dehiscence and fistulous tracts).

Three patients with Chronic Osteomyelitis, hospitalized at the "Fructuoso Rodríguez" Orthopedic Teaching Hospital, were selected. Two of these patients had fistulous tracts that were resistant to closure, despite the conventional treatment applied. In the third, there was a predominance of the ulcerated area (secondary to multiple surgeries) over the fistula.

The participants signed the Informed Consent, a document established by the Ethics Committee of the aforementioned medical center and by international regulations.

The use of a therapy applying electrical stimulation is proposed (use of self-adhesive electrodes in the area near the injury every day for (1) hour) in combination with conventional treatment.

Case 1

A 57-year-old male patient, with an apparent health history, who at eight (8) years of age suffered a traffic accident that caused an exposed supracondylar fracture in the lef femur. After a year with skeletal tractions, he had to undergo surgery. Later, due to septic complications, it evolved into chronic osteomyelitis of said limb, requiring multiple surgeries for this reason. As a consequence of these treatments, in 2017 he was diagnosed with a superficial chronic ulcer on the left thigh, with signs of infection and where conventional treatments based on the use of parenteral antibiotics, cures and the use of the Toilette technique did not work desired effect.

As of November 1, 2023, the application of electrical stimulation combined with conventional treatment began, using Stimul W®. The surface area of the lesion was measured (initial value 16.21 cm2), once a week, with the aim of analyzing the action of this joint therapy.

The measurements were carried out using the ImageJ system, which is an Image Processing Program, for public use, based on the Java Programming Language, developed at the National Institutes of Health, the Laboratory for Optical and Computational Instrumentation (LOCI, University of Wisconsin) and the University of Cambridge [16].

During the first week of treatment, a decrease in suppuration in the lesion was observed, although there was no significant decrease in the lesion surface area and there was improvement in the patient's pain. In the second week the lesion stopped suppurating. A decrease in the surface area (12%) was observed compared to the previous measurement and the absence of pain continued.

In the following week, an increase in granulation tissue was observed. The bloody areas had disappeared. There was no discharge or pain and growth of epithelialization was observed. Finally, at the fourth week the lesion continued in the process of remission, decreasing its surface area until complete healing and elimination of secretion - as macroscopic evidence of the suppression of the infection.

Case 2

A 46-year-old female patient, with an apparent health history. In August 2016, he suffered a traffic accident, resulting in a fracture of the middle 1/3 of his right femur. She underwent surgery, where a reduction and osteosynthesis of the fracture was performed. After surgery (10 days later) a septic process begins, which is treated with antibiotics and the cures indicated for these cases, including the application of plasma. However, it turned into chronic osteomyelitis, for which she underwent several surgeries (Toillete, debridement, packing and Masquelet technique to cover the existing bone defect.

Since the end of July 2023, a dehiscent wound has occurred, secondary to surgeries, which became a fistulous tract and became resistant to conventional treatment (more than three months without achieving closure of the fistulous tract).

As of November 1, 2023, the application of electrical stimulation began in conjunction with conventional treatment, using Stimul W®, with the corresponding weekly measurement of the surface area of the lesion (initial value 3.02 cm2).

During the first week of treatment, a decrease in suppuration of the osteomyelitis lesion through the fistula was observed. An evident acceleration of healing was also observed, where the surface area decreased by 32% compared to its initial value and there was no reference to pain. In the following week, the decrease in suppuration continued and, although the surface area of the lesion decreased (3% compared to the area of the previous measurement), a slowdown in the healing process was observed and there continued to be no reports of pain.

In the week that followed, the behavior was quite similar to the previous one, although a certain decrease in the surface area was noted. Complete healing occurred in the fourth week.

Case 3

51-year-old male patient with APP of Diabetes Mellitus, type II. He underwent Total Arthroplasty of the left Hip approximately 15 years ago, which resulted in Chronic Osteomyelitis. In 2021 he underwent surgery for Prosthetic Loosening. Two years later he suffered prosthetic dislocation and was operated on again, showing an atypical reaction to the suture, due to which he was taken again to the Operating Room for treatment under anesthesia on multiple occasions, leaving a fistula in the left hip as a remnant. Cultures and antibiograms of the lesion were performed, demonstrating the presence of pathogenic microorganisms (Pseudomonas). In these three years he has been treated with conventional therapy, without achieving significant improvement in the estimated time.

As of November 20, 2023, the application of electrical stimulation began in conjunction with conventional treatment, using Stimul W®, with the corresponding weekly measurement of the surface area of the lesion (initial value 0.58 cm2).

Throughout the treatment, the behavior of the healing process occurred in a similar way to that explained in case 2.

Results

The graphic combination in Figure 1 shows the initial and final photos of the ulcer that patient 1 (HOFR_1) presented before and after the application of the combined therapy, where complete healing was achieved in less than a month of treatment.

Figure 1: Initial and Final Photos of the Electrical Stimulation Treatment of Case 1

Similarly, Figure 2 shows the initial and final states of the fistula presented by patient 2 (HOFR_2), who achieved complete healing of the lesion in approximately 27 days.

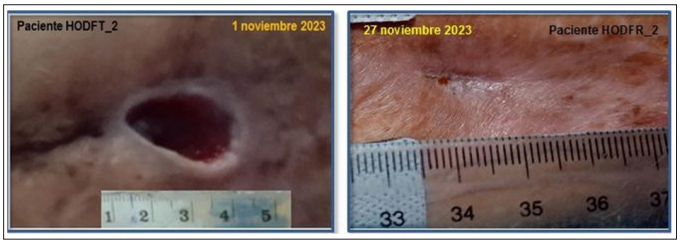

Figure 2: Initial and final photos of the electrical stimulation treatment of Case 2

From case 3 (HOFR_3) with a behavior in the healing process very similar to case 2 as explained previously (closure of the fistulous tract in 21 days). Graphic evidence is not shown for reasons of space in this article.

Conclusion

The satisfactory results of the study allow us to consider electrical stimulation, using Stimul W®, as another alternative for the treatment of lesions that are difficult to heal, secondary to Chronic Osteomyelitis, as it promotes short-term healing of the lesion and provides patient satisfaction, as it is a non-invasive and non-painful treatment.

The application of this technique caused a decrease in secretion through the fistulous tract. This phenomenon could be due to the anti-bacteriostatic and bactericidal effect that the stimulator could offer and which will be the subject of subsequent research.

In all cases, the action of electrical stimulation caused the acceleration of the formation of granulation tissue on the walls of the fistulous tunnel and the ulcerated area, subsequently achieving closure of the lesions in ±30 days, where according to experience and considering previous similar situations, it would have taken approximately ±1 year to heal [17,18].

Contribution of Each Author in the Work

Juan Enrique Suen Díaz

- Main author of the Stimul W® electrical stimulator used in the case study.
- It was part of the preparation of the Work Agreement between the two institutions, as well as the Confidentiality Agreement, aimed at the development of research topics, within which this Case Study is included.
- Prepared the Case Study proposal, the Case Collection Notebook, as well as the Informed Consent proposal for each patient.
- Participated in the application of statistical treatment and control of the daily information obtained.
- Carried out all digital information processing and statistical analysis.
- Participated in the writing and revision of this article

Joel Chirino Abreu

- Lead medical specialist in the case study.
- Provided the medical information of each patient to be included in the Case Collection Notebook, as well as participated in the signing of the Informed Consent of each patient, as the main specialist.
- Participated in the daily application of the treatment.
- Participated in the writing and revision of this article

Antonio Raunel Hernández Rodríguez

- It was part of the preparation of the Work Agreement between the two institutions, as well as the Confidentiality Agreement, aimed at the development of research topics, within which this Case Study is included.
- As Director of the hospital institution, he signed the aforementioned agreements and facilitated all the necessary logistics for the development of the case study.
- Participated and supervised compliance with the application of the proposal.
- Participated in the writing and revision of this article

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Conflict of Interests

I declare that there are no conflicts of interest or financial interests.

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