

Electric Stimulation (E-Stim) in the healing of chronic wounds compromised by bacterial biofilm



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Case Study

The following is a case study of a 'chronic' non-healing wound in which bacterial biofilm was judged to be delay healing. The clinical use of E-Stim overcame this barrier to healing.

EH was an 83 year old lady with a right venous leg ulcer (ABPI of 1.0) of 2 years duration. The ulcer was non-healing, extremely malodorous, and produced copious amounts of exudate. The wound bed was completely covered with slough. The wound measured 13.5cms². (Figure 1).

The patient was unable to tolerate compression therapy, which may have reversed venous hypertension and aided healing. The wound had been previously dressed with a sheet hydrogel.

Within six days of treatment with POSIFECT™ RD the wound had reduced in size and the slough had reduced by 50% (Figure 2). The wound continued to make progress (Figure 3), and after a further 17 days the wound had 100% granulation tissue (Figure 4).

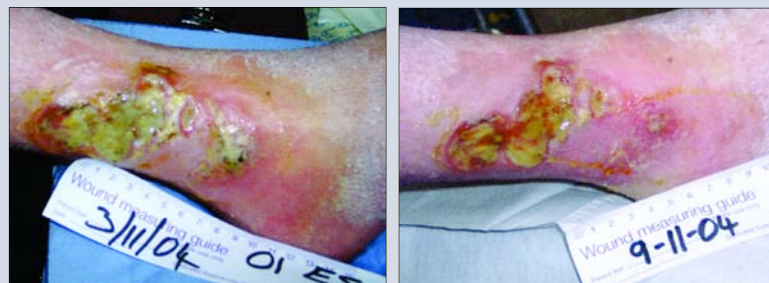


Figure 1



Figure 2



Figure 3



Figure 4

Micro-organisms, particularly bacteria, are known to have a major impact on wound healing.¹ Bacterial colonization and infection are important factors in compromised wound healing, particularly in chronic wounds.² The systematic approach to wound bioburden assessment and control is encompassed in the principles of Applied Wound Management; the Wound Infection Continuum.³ This describes the state of 'Critical colonization' of wounds, a major cause of delayed healing (See Key Concepts).

The mechanisms whereby bacteria act pathologically are known as virulence determinants,^{4,5} one of these - biofilm formation - is a putative factor in wound infection.^{6,7} Common wound pathogens, e.g. Staphylococci and Pseudomonads, are known to form biofilms.⁸ Topical antiseptics are not always an option in treatment, due to tissue toxicity.⁹

Low level direct electric current has been shown to enhance antimicrobial activity^{10,11} and to induce biofilm detachment.¹²

All living tissues possess direct current surface electropotentials that play an important part in wound healing. Wounding causes a current of injury to be generated.^{13,14} This has been shown to be absent in dry non-healing wounds¹⁵ and probably explains the importance of the Moist Wound Healing paradigm. Healing can be accelerated if this current is restored through exogenous means, thus generating a current of healing which plays an important role in the healing of injured tissues.

POSIFECT™ RD is a new wound care therapy that incorporates E-Stim advances with moist wound healing. It works by delivering an external current that mimics the failed natural bio-electric current. The exogenous current attracts positively charged cells, such as fibroblasts, towards the wound area and negatively charged macrophages away from the wound.¹⁵

This therapy has now been evaluated on a variety of chronic wounds and found to be effective in promoting healing.^{16,17} We suggest that one of many modes of action underlying the success of this new therapeutic modality is biofilm disruption in vivo without antimicrobials. This would be the first observation of this mechanism in any pathological state in vivo to our knowledge.

Conclusions

Healing of chronic wounds is likely to be compromised by the presence of biofilm.

Biofilms resist the action of antibiotics and wound phagocytes.

Electric fields are known to prevent biofilm formation, and, to disrupt existing biofilms.

POSIFECT™ RD E-Stim is an interesting new option in the treatment of chronic wounds.

Key Concepts:

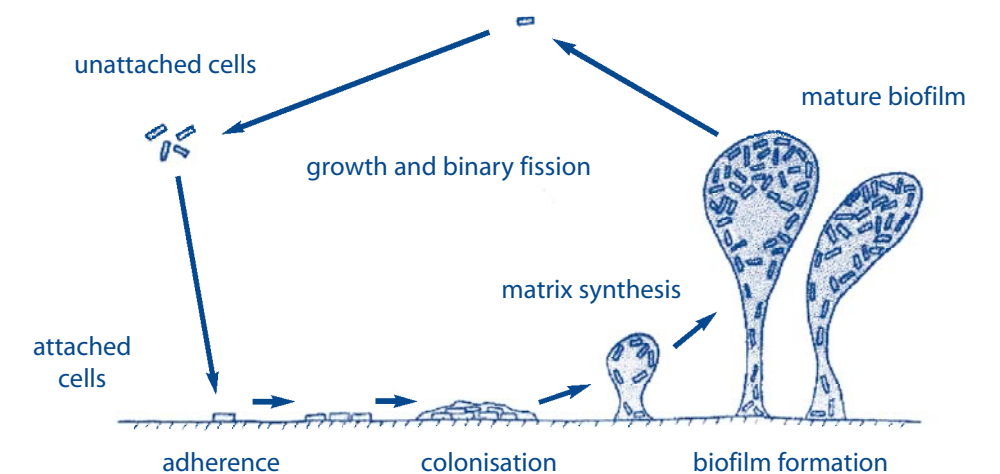
Biofilms: These are bacterial communities living within an extracellular polysaccharide (EPS) matrix produced by bacteria following adhesion to a suitable surface (See figure 1). The EPS provides protection from antibiotics and phagocytes. Biofilms are implicated in many bacterial diseases - such as otitis media, endocarditis, and cystic fibrosis. Biofilms are also implicated in the emergence of resistance strains.

Colonization: The presence of multiplying bacteria with no overt host immunological reaction or clinical symptoms. This definition currently applies irrespective of the numbers and species of organisms present in the wound.

Critical colonization: The inability of the wound to maintain a balance between the increasing bioburden and an effective immune system. This causes a delay in healing but not necessarily deterioration in the wound or other overt signs of clinical infection. It is not necessarily synonymous with local infection.

Electric stimulation (E-Stim): The introduction of a therapeutic current.

Figure 1: A diagrammatic view of bacterial biofilm formation (courtesy of Dr. Rose Cooper)



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