Wearable bioelectronic system for wound healing and management

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Chronic wounds are a significant healthcare challenge, affecting millions of people worldwide.[1] Chronic wounds do not heal within a normal time frame, which leads to severe complications such as infection, amputation, and even death.[2] Chronic wounds can be caused by a variety of factors, including diabetes, vascular disease, and pressure sores.[3] One of the treatments for infected chronic wounds is the use of antibiotics, which depends on the type of infection present.[3] In some cases, surgical debridement may also be necessary to remove infected tissue and promote healing.[1] Chronic wounds often require a multi-faceted treatment approach, and there can be challenges associated with finding the right treatment. One of the biggest challenges is the development of antibiotic resistance, which can make it difficult to treat infections.[4] Additionally, chronic wounds can be slow to heal and may require ongoing care and treatment.[1] It is important to work closely with a healthcare professional to determine the appropriate treatment plan for a chronic wound and to monitor progress regularly to ensure that the wound is healing properly.

Biomaterials such as dressings, scaffolds, and hydrogels can deliver therapeutic agents such as growth factors or antibiotics and provide a supportive environment for wound healing.[5] One promising biomaterial is biodegradable scaffolds that can provide a physical scaffold for cells to grow and proliferate.[6] These scaffolds can be designed to degrade over time, allowing for the gradual release of therapeutic agents and the eventual regeneration of new tissue.[7, 8] Another biomaterial that has shown promise is hydrogels, which can form a gel-like matrix that can hold and deliver therapeutic agents.[9] Hydrogels form a moist environment for wound healing, which is important for promoting cell migration and proliferation.[10] Biomaterials offer a promising approach to the treatment of chronic wounds. These materials provide a supportive environment for wound healing and can also deliver therapeutic agents to promote healing.

Wound management is an important aspect of healthcare, and recent advancements in technology have provided new opportunities for preventing these complications and achieving effective wound healing.[1] Wearable bioelectronic systems and biomaterials are promising solutions for the treatment of chronic wounds, offering real-time monitoring and treatment as well as supportive environments for wound healing.[11] Shirzaei Sani et al.[12] reported a wearable patch that wirelessly and continuously monitors the physiological conditions of the wound bed via a custom-developed multiplexed multimodal electrochemical biosensor array and performs noninvasive combination therapy through controlled anti-inflammatory antimicrobial treatment and electrically stimulated tissue regeneration (**Figure 1**).

Wearable bioelectronic systems have emerged as a promising solution for wound management due to their ability to constantly monitor and regulate wound conditions.[11] These systems consist of a wearable device that is placed directly on the wound and is equipped with sensors and bioelectronic components.[13] The sensors are used to monitor wound conditions such as temperature, pH, and moisture levels.[14] The bioelectronic components are then used to deliver appropriate treatments, such as electrical stimulation or drug delivery, to promote healing.[11, 15] One of the key advantages of wearable bioelectronic systems is their ability to provide real-time monitoring and treatment.[16] This allows for timely interventions and can prevent complications that may arise from delayed treatment. Additionally, these systems are non-invasive and can be worn for extended periods, allowing for continuous monitoring and treatment.[17] Wearable systems have already shown promising results in pre-clinical trials and are now being tested in clinical trials (NCT03948360). These systems have the potential to revolutionize wound management and improve patient outcomes.

In conclusion, wearable bioelectronic systems offer a promising solution for wound healing and management. These systems are non-invasive,

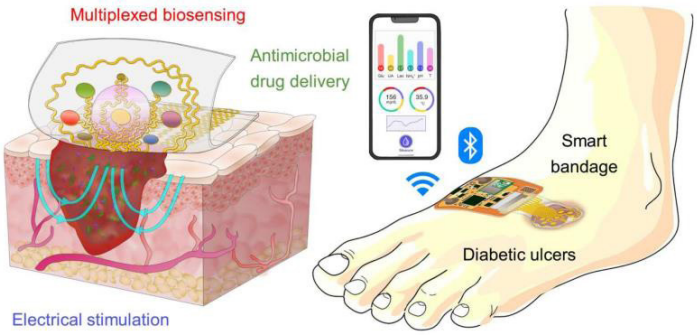

Figure 1. A wireless stretchable and wearable bioelectronic system for multiplexed monitoring and treatment of chronic wounds.[12]

and provide real-time monitoring and conditional responsive treatment for chronic wounds. As technology continues to advance, it is likely that wearable bioelectronic systems will become more widely available and have an even greater impact on healthcare.

Author contributions

YP: Conceptualization, resources, writing-review & editing, supervision, project administration; XC: writing-original draft, writing-review & editing. Both authors approved the final version of the manuscript.

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Conflicts of interest statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this study.

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