Smart Hydrogel Bandage: Real-Time Wound Healing with Integrated Monitoring for pH, and Healing Status

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Abstract:

Smart bandages offer constant monitoring and facilitate effective healing, which is a major breakthrough in wound treatment. This study investigates the creation and use of a smart bandage that monitors important variables like pH, and the presence of microorganisms on the wound bed. The hydrogel used in the bandage is made from polyvinyl alcohol (PVA) and aloe vera. A biocompatible and functional hydrogel is produced by combining PVA, a synthetic polymer recognized for its film-forming, emulsifying, and adhesive qualities, with aloe vera, a natural material well-known for its antibacterial and restorative qualities. PVA and aloe vera are blended during the synthesis process to create a homogenous hydrogel matrix. Additional embedded sensors in this matrix are able to measure and detect temperature, microbial activity, and pH. The pH sensor provides vital information about the state of the wound by using colorimetric shifts to identify the acidity or alkalinity of the wound environment. A pH difference from the standard range may indicate an illness or a delayed healing process. The hydrogel is equipped with temperature sensors that track the temperature of the wound bed. High temperatures are frequently indicative of inflammation or infection. The microbial detection device provides real-time insights into the microbiological condition of the wound by identifying and quantifying the microbial load using biosensors. The pH sensors demonstrated a reliable color change in response to different pH levels, while temperature sensors accurately tracked fluctuations in wound temperature. The microbial detection system successfully identified bacterial presence, providing quantitative data essential for early infection diagnosis. This real-time monitoring capability facilitates timely medical interventions, potentially reducing the risk of complications and improving healing outcomes. In summary, the development of a smart bandage using PVA and Aloe vera hydrogel marks a significant innovation in wound care. This bandage provides continuous, real-time monitoring of pH, and microbial load, offering valuable data for medical professionals and improving patient outcomes.

Keywords: Smart bandage, hydrogel, polyvinyl alcohol (PVA), Aloe vera, pH, microbial detection, wound care, biocompatibility, antimicrobial properties.