Nanofibrous hydrogels applied to burn wounds can accelerate healing and enhance the regeneration of skin tissue

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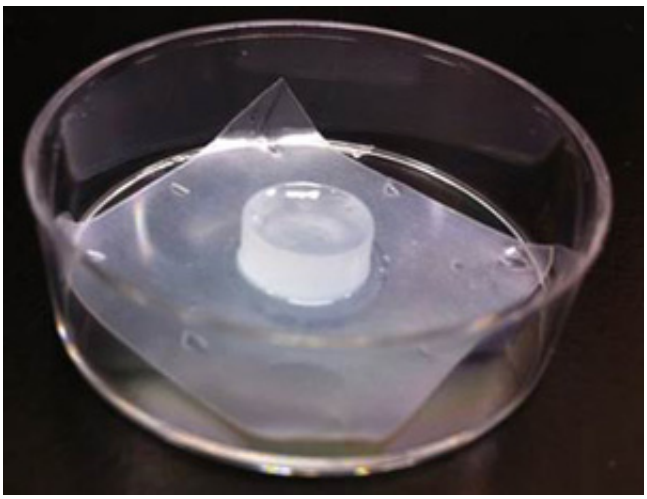

A circular sample of a peptide nanofibrous hydrogel in a glass dish. Credit: A*STAR Institute of Bioengineering and Nanotechnology

Healing of burn wounds requires that dead tissue is removed and new skin tissue is regenerated, while ensuring that the wound is closed rapidly to minimize the risk of infection and scar formation. A*STAR researchers now report non-immunogenic and non-cytotoxic hydrogels composed of nanofibrous peptide assemblies, which expedite wound closure and promotes epithelial and dermal regeneration almost twice as fast as existing wound dressings.

Current methods of burn care, which include gauzes, hydrogels, hydrocolloids, foams and films made from natural or synthetic materials, are in need of improvement. Mepitel, for example, is a silicone-coated polymeric net, which maintains gaseous permeability to the wound but not the hydrated environment required for healing.

Charlotte Hauser and colleagues at the A*STAR Institute of Bioengineering and Nanotechnology in Singapore show that the nanofibrous hydrogels, composed of assemblies of short and easy-to-synthesize peptides, effectively promote in vivo wound healing. The transparency of the hydrogel allows the wound to be observed during the recovery process.

"Our ultrashort peptide-based hydrogel virtually fulfills all the criteria essential for accelerated wound healing," says Hauser. "The hydrogel can provide a moist environment as a consequence of its extremely high water retention capacity of up to 99.9%, which, to our knowledge, is unmatched by currently available wound dressings."

This moisture-rich environment stimulates the removal of dead tissue in a process termed autolytic debridement. Encouragingly, the hydrogel-treated wounds show autolytic debridement on day 8, whereas for Mepitel-treated wounds it is not observed until day 10. The knock-on effect of this enhanced tissue removal is that the hydrogel-treated wounds close faster. By day 14, the researchers noted almost complete regeneration of the epidermal layer for the hydrogel-treated group and also observed the presence of precursors for the formation of hair follicles.

Hauser and colleagues aim to investigate if other therapies could be combined with the hydrogels, such as the addition of compounds—for example anti-infectious drugs—to further speed up wound closure.

Other applications are also possible, adds Hauser. "We plan to probe the healing properties of the hydrogel in chronic skin wounds such as bed sores and diabetic ulcers."

"Considering the long shelf-life stability of sealed peptides stored at room temperature, we are particularly keen to develop 'just-add-water' formulations," says Hauser. "This would involve the addition of a fixed volume of clean water to the peptide powder at the point of application, which would greatly reduce transportation costs and potentially revolutionize emergency medicine for burn wounds in war zones and developing countries."

More information: Loo, Y., Wong, Y.-C., Cai, E. Z., Ang, C.-H., Raju, A. et al. "Ultrashort peptide nanofibrous hydrogels for the acceleration of healing of burn wounds." *Biomaterials* 35, 4805–4814 (2014). dx.doi.org/10.1016/j.biomaterials.2014.02.047

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