Regenerative Properties and Wound Healing of a Novel Far-Infrared Ceramic-Blanket

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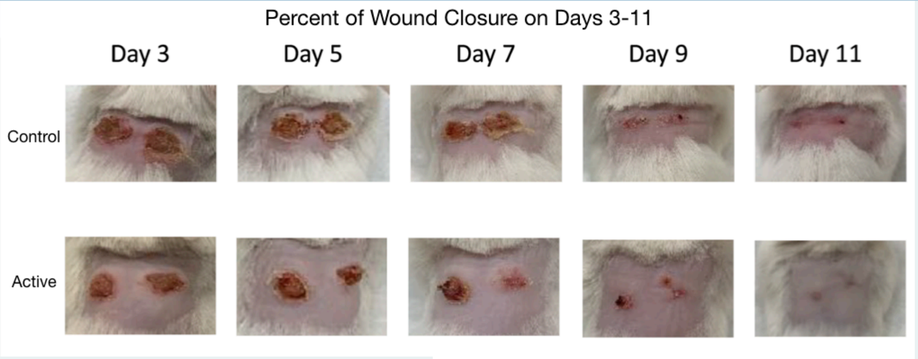
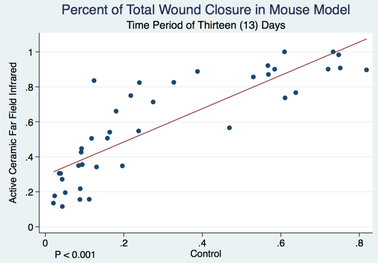
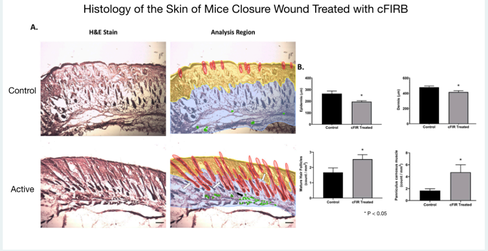
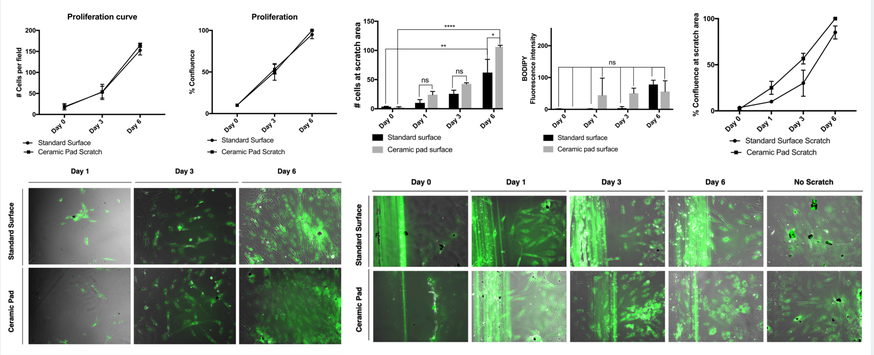






A. H&E epidermis (yellow), dermis layers (blue), mature follicles (red), and panniculus carnosus vessels (green).
B. Active has compact epidermis & dermis layer vs control, higher presence of mature hair follicles, fully extending from the dermis to epidermis vs control, panniculus carnosus vessels count higher vs control showing regeneration of muscle layer suggesting efficient wound closure.



Proliferation, healing and migration of MSCs in active and control. Fluorescence intensities emitted from BODIPY dye did not change significantly, suggesting that the cells did not divide but move.

Context: There is increased complexity in the treatment of surface area wounds suffered by military personnel. Technology that might accelerate wound healing is associated with many benefits to injured personnel and our society.

Objective: To test the effectiveness of a novel ceramic crystal-induced far-infrared (cFIR) on wound healing in a mouse and mesenchymal stem cell (MSC) model.

Setting and participants: Eight male BALBc mice were housed in standard ventilated cages with 4 mice assigned to the active cFIR treatment group and 4 to a control group. The active group were placed in cages over cFIR blankets & controls without cFIR.

Interventions: Using a single-use sterile 5 mm diameter circular biopsy punch, full-thickness, symmetrical excisional wounds were created through the panniculus carnosus. MSCs subcultured and injured with a pipette scratch wound.

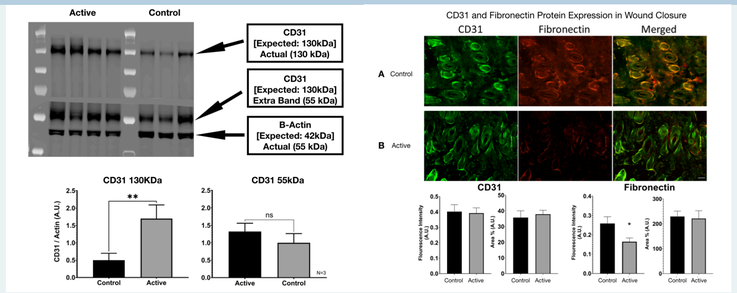
Ethical approval: All procedures were performed in accordance with the institutional guidelines of the Institutional Animal Care and Use Committee of the University of Central Florida (protocol no. 202000105).

Main outcome measures: Daily measurement of wound closure, Immunocytohistochemical analysis & MSC wound healing measurements.

Methods: Review Abstract MHSRS-21-03823

Results: Mice treated with the cFIR ceramic blankets showed a compact epidermis and dermis layer compared to untreated mice at day 13 post-puncher wound, and treated mice had a higher presence of mature hair follicles, fully extending from the dermis to the epidermis, compared to untreated mice. The Panniculus carnosus vessels count was higher on cFIR treated mice wounds showing the muscle layer's regeneration, suggesting an efficient wound closure. Mice treated with cFIR showed significant changes in Platelet endothelial cell adhesion molecule (CD31) protein expression and an early increase in Fibronectin expression with a significant decrease in Fibronectin expression at the end of the study. The healing time of wounds of mice treated with cFIR was significantly accelerated, and the differences in healing times between the treatment and control mice were associated with extremely high statistical and substantive significance ($P < 0.001$). MSCs demonstrated increased migration into the wound without proliferation and significant healing over control MSCs ($P < 0.001$).

Conclusion: Improved wound healing has been demonstrated in a mouse and MSC model exposed to cFIR. Our findings are novel and have not been investigated or reported previously. The utilization of cFIR in military wound healing applications may be promising in many situations with no need for a direct or battery power source. The technology is entirely autonomous and lightweight making its application possible in military environments.



Western blot quantification of cFIR treatment shows significant increases of CD31 protein expression in active vs controls. Immunohistological fluorescence shows Fibronectin expression in controls after active has healed.

cFIR Blankets manufactured for this study
by Gladiator Therapeutics
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