Quantitative assessment of wound healing using high-frequency ultrasound image analysis

ABSTRACT

Purpose: We aimed to develop a method for quantitative assessment of wound healing in ulcerated diabetic feet. Methods: High-frequency ultrasound (HFU) images of 30 wounds were acquired in a controlled environment on post-debridement days 7, 14, 21, and 28. Meaningful features portraying changes in structure and intensity of echoes during healing were extracted from the images, their relevance and discriminatory power being verified by analysis of variance. Relative analysis of tissue healing was conducted by developing a features-based healing function, optimised using the pattern-search method. Its performance was investigated through leave-one-out cross-validation technique and reconfirmed using principal component analysis. Results: The constructed healing function could depict tissue changes during healing with 87.8% accuracy. The first principal component derived from the extracted features demonstrated similar pattern to the constructed healing function, accounting for 86.3% of the data variance. Conclusion: The developed wound analysis technique could be a viable tool in quantitative assessment of diabetic foot ulcers during healing.

Keyword: Dermatologic sonography; Diabetic foot ulcer; Healing function; High-frequency ultrasound imaging; Image processing; Pattern search optimisation; Wound healing assessment