

Imaging Techniques Used for Wound Healing Assessment

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Abstract

Background: An objective assessment of wounds carries both prognostic and diagnostic values thus determine treatment strategies and objectively examine the efficacy of emerging and novel wound therapies. Therefore, the aim of this article is to evaluate several objective imaging based wound assessment techniques.

Methods: Electronic databases were searched for all available publications on the use of wound assessment devices on human and artificial wounds using appropriate search terms. The primary outcome was the reliability and reproducibility of measurement whilst the secondary outcome was the feasibility of the instrument. All studies underwent quality assessment of diagnostic accuracy studies (QUADAS) to examine the quality of data.

Results: Forty-four articles were identified evaluating 11 instruments which were divided acute wound measuring devices and chronic wound measuring devices. Average QUADAS score was 11 with lowest at 9 and highest 14. The highest performing instrument for acute wound healing was multiphoton tomography. It provides morphological assessment at a histological level, and details physiological status through optical redox ratio autofluorescence. However, its current high cost would therefore limit its use to research rather than clinical setting. The 3D system is ideal for wound assessment of chronic wounds. The combination of portability and ease of use outperforms hyperspectral imaging, OCT and MPT, whilst its accuracy is superior to 2D imaging

Discussion/Conclusion: This was an article which compared the performance of instruments for chronic and acute wounds. The article provides an extension into three further articles which provide a more in-depth review of the performances of the described instrument.

Keywords: Wound healing • Objective measurement • Mobile application • Wound measuring device

Introduction

An objective evaluation of wounds is necessary to determine the progression of healing which guides treatment strategies.

UK standards

In the UK, majority of wound care is in the community and is dependent on a subjective wound assessment. In a study on community based surgical wound management [1] identified a number of emerging concerns. 1) Variations in documentation standards and terminology used for both wound nature and infection 2) lack of secondary care and specialist advice 3) apparent lack of treatment planning, reassessment, and revaluation of care. This has resulted in increased re-admission rates and patient morbidity. The study highlights the need for common definition reporting standards, integration of care across providers and early senior involvement.

Research problem

The evidence above suggest that an objective, validated wound assessment method is required in wound care [2]. However current practices are based on clinical assessment, wound assessment scoring and histological studies which can be subjective and vulnerable to bias.

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Clinical assessment

The most common method of wound assessment is clinical. Unfortunately, due to the nature of wound assessment, inaccuracies and inconsistency can be found Kantor and Margolis found inter-rater variability due to body natural curvature when assessing wound circumference [3], whilst Johnson and millet demonstrated lack of reproducibility between clinicians when objectively and subjectively monitoring wound progression by assessing depth [3]. In another study by Mekkes and Wastehof, intra and inter variation was noted when reporting visual estimation of percentage area [4]. Evidently wound assessment with this method has a degree of unavoidable bias.

Assessment tools

Wound staging and assessment tools were developed in hopes to unify and develop better reliability between wound assessments. In a systematic review by Heath P, et al. [5], which assessed the validity of 10 different clinical tools including pressure ulcer scale for healing (PUSH), Pressure sore status tool assessment scale (SS) and Sussman wound healing tool, none achieved all the requirements for instrument validation with respect to content and criterion validity, intra and inter-rater reliability and sensitivity to change, although PUSH tool and PSST were validated to greatest extent [5]. The evidence suggests that the dependency of a subjective assessment and lack of an establish gold standard to compare, significantly limits its performance [5].

Histological assessment

Histopathological study remains the most commonly used in wound healing research. Whilst it is consider a gold standard [6], There are a number of potential disadvantages. First, an ideal grading system for wound healing has not been established, therefore results could defer depending on clinical site [7–9]. Second, serial evaluation cannot be achieved due to local destruction of tissues which may worsen the wound. Third, increased morbidity of the patient due to infection and pain. Finally, lack of appreciation of physiological changes

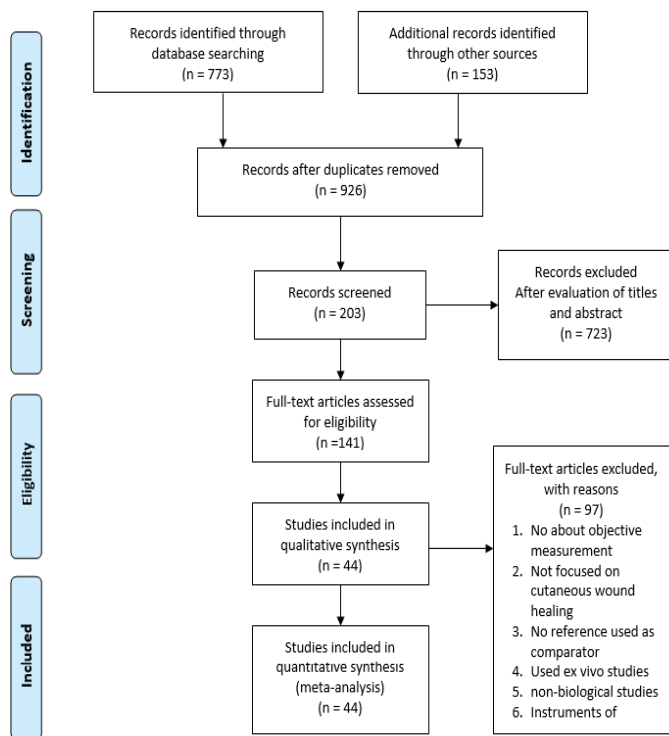


Figure 1. Prisma flow chart.

(deoxy/oxy hemoglobin and water fraction) in wound healing due to the static nature of the analysis [10-25].

AIM

The purpose of this review is to provide a short description of the performance of various non-invasive Imaging techniques used for wound healing assessment described in the literature.

Literature Review

A systematic literature search was done using PICO strategy. Adults and animals with acute, chronic, burn or grafted wounds was the population, with histopathological analysis or clinical assessment of healthy tissue as the comparator, where available. The primary outcome was the validity and reliability of the instrument whilst the secondary, Medline, Pury outcomes was its feasibility such as speed of assessment, ease of use and cost of tool. ASSIA, Cochrane library, EMBaseMed and the knowledge network Scotland were systematically searched with appropriate Mesh terms employed. All studies underwent Quality Assessment of Diagnostic Accuracy Studies (QUADAS) to ensure quality of data.

Conclusion

A total of 773 articles were produced from the initial search, and additions 153 were added when examining systematic reviews/metanalysis of similar nature. In combination a total of 926 articles were generated after duplicated were removed. After filtering by review of titles and abstracts 203 suitable articles were chosen and 723 articles were excluded. Full articles were obtained, and a further 91 articles were removed after evaluating the full text. A total of 44 articles were selected in the final review. The selection process was outlined in Figure 1. All studies were published from 1998 and onwards. The flow chart of inclusion and exclusion studies is presented in Figure 1. The average QUADAS score was 13 with a range of 9 to 14.

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