

COMPARISON OF DIFFERENT IMAGING TECHNIQUES USED FOR CHRONIC WOUNDS

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Abstract

Many people suffer from chronic wounds .It is a major problem in healthcare .worldwide. The treatments of chronic wounds include monitoring colour and size (area or volume) of the wound at regular intervals. This evaluation is often based on qualitative observation and manual measurements of the wound.

Now a days there several researchers are developing technologies to assess the clinical improvement of chronic wounds. This paper aims to provide a study on imaging technologies applied to chronic wounds. A study on imaging technologies applied to chronic wounds is presented. Their reliability, precision, and usage are compared. The methods are divided into three categories: planimetric techniques, volumetric Technique and tissue classification.

Keywords: chronic wounds, 2D, 3D, imaging, techniques, tissue classification.

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1. INTRODUCTION

Chronic wounds are a annoying problem in the healthcare. The most typical chronic wounds are pressure, venous and diabetic ulcers, which mainly affect geriatric population, or patients who have lost totally or partially their capability of mobility causes decomposition and necrosis of subcutaneous tissue, fat and muscle.. On the other hand, diabetic ulcers occur mainly due to two chronic complications: neuropathy and vasculopathy. It is a critical task to perform an accurate diagnosis and to select a suitable treatment. Clinical studies have shown that the reduction of a wound size is a good indicator of healing in most chronic wounds. patient with amputation of the limbs have suffered of a wound previously In many cases of amputations require the removal of the lower limb.. Finally, venous ulcers usually appear in the lower limbs due to chronic venous insufficiency.Many people reported re-occurrences even after a long period of treatment.

Chronic wounds may also appear as the clinical manifestation of a disease. Cutaneous Leishmaniasis is one example mostly found in tropical and subtropical areas. .It is a critical task to perform an accurate diagnosis and to select a suitable treatment. Clinical studies have shown that the reduction of a wound size is a good indicator of healing in most chronic wounds. Additionally, colour may provide relevant information about tissue type and inflammation. Therefore, monitoring the size and aspect of the wound at regular intervals is part of the standard clinical practice. Nevertheless, this evaluation is mostly based on qualitative observation and manual measurements.

In this paper, a study on imaging technologies applied to chronic wounds is presented. Their reliability, precision, and usage are compared. The most common methods used by the clinicians are discussed here. They are mainly based on manual approaches for estimation of the area of the wound and, therefore, they suffer from high inaccuracy. These methods may be divided into techniques that measure area and perimeter, and techniques that measure volumetric information. The first method uses a ruler (or a caliper) to measure the major and minor axes of the lesion. Based on these two measurements, the area of the wound is estimated as a rectangle or as an ellipse. When the model is a rectangle, the area may be overestimated by 10% to 45% with less accuracy for smaller wounds .When the model is an ellipse, it was reported an error between 16% and 40% of the real area . In either model, the decision of the major axes is subjective and has an impact on the variability of the method. In second approach a transparent film is placed over the wound and tracing the outline with a permanent marker. Afterwards, the film is placed on a metric grid and the area is calculated by counting the number of squared millimetres contained within the outline. This process is prone to human error. Several studies have shown that the most important factor in error measurement is the correct and consistent identification of the border of the wound due its poor definition or the subjectivity of the process . Also, the number of partial squares of the grid inside the outline and the thickness of the marker may cause some inaccuracy.

All the described techniques require direct contact with the wound to measure or estimate its area. Some other techniques have been evaluated to estimate the volume of the wound by

filling it with liquid or measuring it by using a cast model. These methods are highly invasive and are not commonly used clinically.

2. PLANIMETRIC TOOLS

DERMA, which allows to measure and assess the time evolution of chronic wounds. A laser triangulation 3D scanner is used to acquire the wound geometry with high precision and to capture an RGB image aligned to the geometry. DERMA provides a single and uniform interface to manage patient data, 3D scanning of the lesion region, and to perform different kinds of measurements and comparisons: geometric (on the 3D model) and colorimetric (on the image) Assessment of pressure ulcer status and healing presents a challenge to nurses, having the primary responsibility for evaluation of pressure ulcers. This challenge is complicated by the lack of a standardized method of measurement of wound healing in pressure ulcers. Two tools for measurement of pressure ulcer wound healing are the Bates-Jensen Wound Assessment Tool (BWAT) and the Pressure Ulcer Score of Healing (PUSH). The developmental history, psychometric properties, scoring and score interpretation, subject burden, and use of the tools were analyzed for usefulness in the clinical and research settings. The BWAT and PUSH tools provide valid and reliable means of assessment of pressure ulcer characteristics and prediction of wound healing. The tool BWAT (Bates –Jensen wound assessment tool) that includes a touch pad compatible with video cameras. The software calculates not only the area of the wound but also the percentages of tissue types. The selection of the wound border and the tissue types is manual. One downside of this tool is the requirement for specialized hardware “NPUAP recommends use of the PUSH Tool at ‘regular intervals.’ The AHCPR Treatment Guideline commends assessments be performed ‘at least weekly’ and ‘if the condition of the patient or of the wound deteriorates.’ The PRESSURE ULCER HEALING CHART (which is attached to the PUSH Tool) will allow you to graph PUSH Tool scores over time for each ulcer. You should be able to ‘tell at a glance’ whether the ulcer is healing, remains unchanged, or is deteriorating... Any increase in the PUSH Tool score (indicating wound deterioration) requires a more complete assessment of the ulcer and the patient's overall condition.” The PUSH Tool, which monitors a wound's length and width, exudate amount, and tissue type, is best used as a method for predicting wound healing.

3. VOLUMETRIC METHODS

In order to assess the dimensions of a wound more accurately, some researchers have focused on obtaining three dimensional models to measure not only area but volume. Metrics obtained from these models and their rate of change in time may provide clinicians with useful diagnostic information. Current 3D methods have been developed to

obtain more accurate measurements without the constraint of the view-angle of a device. In that context, researchers have explored two methods for three dimensional reconstructions, active or passive scanning.

3. TISSUE CLASSIFICATION

All four tissue types can be present on the ulcer surface. The appearance of the ulcer is important in diagnosing and assessing its healing status. The ulcer contains four main types of tissues: Necrotic, Slough, Granulation and Epithelial. At any one time throughout the healing process, all four tissue types can be present on the ulcer surface, doctors normally describe the tissues in-side the ulcer in terms of percentages of each tissue colour based on visual inspection. However, human vision lacks precision and consistency and hence is not sufficient to perform such analysis. Moreover, chronic wounds evolve gradually over time as they heal, hence the detection of slow changes with simple visual inspection might be difficult. Thus, imaging techniques are developed to identify different types of tissues objectively and aid medical practitioners in evaluating the healing status of ulcers. Most recently, an unsupervised wound tissue segmentation method was proposed. The method utilizes three selected unsupervised segmentation methods to segment wound images into different regions. It then extracts both colour and texture descriptors from RGB colour images as inputs to a classifier for automatic classification and labeling of these regions. Most of the work developed in the field of wound assessment utilized colour content representation in RGB colour images of wounds as the main component for analysis. One of the most prominent changes during wound healing is the colour of the tissues.. Digital photography is a practical and low-cost imaging technique, which provides valuable information about the appearance of the tissue under study. However, changes in the deeper layers of tissue, including those in the early stages of pressure sore generation, cannot be investigated using this technique. HFU on the other hand has been utilized for studying deeper tissue damage which is not visually recognizable. This technique seems to be a good candidate for estimating the undermined tissue, considering its lower cost in comparison with the other imaging techniques (e.g. CT and MRI) and potential to be used in small offices or clinics. Measurement of wound healing status is very important for monitoring progress in individual patients. Tissue classification is a vital step in the development of an automatic measurement system for wound healing assessment.

CONCLUSIONS

We have discussed 2D and 3D techniques. Although the 2D is easier to implement and even to manipulate by healthcare technicians, there are important points in favour of the 3D. Measurements from 2D techniques are influenced by lighting conditions, camera position and angle of acquisition. Also, there is an intrinsic loss of information on the representation

of 3D real world information on an image. On the other hand, 3D techniques could produce more metrics from the wound such as perimeter, depth, area and volume. It is true that these techniques require more specialized equipment. These new techniques reported very promising results on increasing accuracy in size measurements while reducing inter and intra-observer variability, they have not been adopted in clinical standards.

Most of the newly developed devices, even low-cost and user-friendly ones, seem to stay at the test stage. There is clearly a lack of clinical results to support their use. Therefore, research on their clinical relevance should be emphasized. vision-based technologies can be combined with other technologies such as multi-spectral, hyper-spectral and ultrasonic imaging for more accurate and reliable tissue characterization combining 3D surface and color information could improve this task .

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