Acta Biomed 2021; Vol. 92, N. 5: e2021227 DOI: 10.23750/abm.v92i5.11179

Original article

Wounds morphologic assessment: application and reproducibility of a virtual measuring system, pilot study

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Abstract.

Background and Aims. Assessment of wounds morphology can be considered, in the everyday medical activity, the first step for the correct pathway of diagnosis. Authors present a pilot study focused on the statistical analysis of 32 cases of wounds measurements conducted by both the traditional method (paper ruler) both the digital smartphone analysis. *Materials and Methods.* 32 lesions were morphologically evaluated. All the enrolled patients were evaluated by both the traditional method (paper ruler) both a digital smartphone analysis based on the app imitoMeasure©. The extracted data were compared to the traditional measurements and a statistical analysis was based on intraclass correlation coefficients (ICC). *Results.* Three morphological parameters were evaluated: width (expressed in cm), length (expressed in cm) and area (expressed in cm^2). The area (expressed in cm^2) was found to be the less comparable, but the data were close in this case, too. *Conclusion.* The present study shows that the digital measuring systems should be easily addressed as versatile tools that could be applied in daily clinical practice in the future. (www.actabiomedica.it)

Key words: wound care, skin lesions, technology, measurement, digital imaging

Background and Aims

Lesions of skin and soft tissues are widely included among the most frequent wound types diagnosed in the hospital environment (1). Assessment of wounds morphology represents, in the everyday medical activity, the first step for the correct pathway of diagnosis (2). In this perspective, the traditional measurement methods (paper rulers) are about to be enriched by the newest ways to use technology in the everyday clinical practice, which represent the future of wound care (3). Costs and subjective variations can be considered as the main obstacles these devices must face. The ideal method should be unexpensive, versatile and easily reproducible. The advent of last generation smartphones, equipped with high resolution cameras, gives the chance to look for this solution into a downloadable app. Authors present a pilot study focused on the statistical analysis of 32 cases of wounds measurements conducted by both the traditional method (paper ruler) both the digital smartphone analysis.

Materials and Methods

This pilot study was conducted at the Surgical Division and at the local referral center of wound Care of Parma Hospital (Parma, Italy). This work was approved by the local Ethics Committee of Emilia Romagna (AVEN) and all the patients gave their in-

formed consent before the enrollment. Authors included patients available to undergo subsequent follow-up of the study and capable of providing informed consent. On the other side, patients not available to undergo subsequent follow-up of the study and unable to provide informed consent were excluded. 32 lesions were morphologically analyzed. All the enrolled patients were evaluated by both the traditional method (paper ruler) both a digital smartphone analysis based on the app imitoMeasure © (owned by imito AG ©, all rights reserved). The app was tested on Apple iPhone X device running iOS 13 and it includes functions for photography, documentation, capture and measure of cutaneous wounds. All the pictures were taken from a 25 cm distance by the same device and all the collected data were encrypted. A parallel traditional measurement with a paper ruler was taken for every lesion, too. In order to obtain digital measurements, a calibration marker (2 cm diameter) was positioned next to the wound prior to take the picture. This adhesive is used by the system to calibrate colors, distances and spaces, so that the width, the length and the area of the lesion can be calculated. The extracted data were compared to the traditional measurements and a statistical analysis was based on intraclass correlation coefficients (ICC) calculated using a PC running SPSS version 18. Internal reliability was considered as "excellent" for ICCs = 0.90-1.00.

Results

32 patients, aged between 66 and 87 years (median age: 76,2), were enrolled for this pilot study over a one-year period (from March 2019 to February 2020). The evaluated lesion types (one for each patient) were classified as follows: 14 surgical site lesions - (44 %); 9 infectious or vascular etiology (SSTIs) – (28%); - 9 presented ulcers from mixed etiology (28%). Three morphological parameters were evaluated: width (expressed in cm), length (expressed in cm) and area (expressed in cm^2). Each measurement was taken three times at a distance of 25 cm and the statistical analysis allowed authors to calculate intraclass correlation coefficients (ICC). Considering the width and the length, the digital measurements resulted really close (in the most of cases identical) to the traditional (ICC = 0,99 for each) (Table 1). The area (expressed in cm^2) was found to be the less comparable (ICC = 0.95) (Figure 1), but the data were close in this case, too.

Discussion

Wounds morphological assessment represents a fundamental preliminary phase in everyday clinical practice (4). Its imprecise execution can potentially lead to suboptimal wound care, delayed healing, increased risk of infection and major economic impact, too, as underlined by Wang et al. (5). During the preliminary wound assessment, dimensional parameters (such as width, length, depth) are described as well as the general condition of the skin, the chromatic parameters and the global appearance of the lesion (6).

The present hi-tech era gives the great opportunity to obtain objective and reproducible measurements, as described by Khong et al. (7). Although the paper ruler represents the cheapest method, modern technology offers new strategies in this field, as well as the digital wound photography. In this scenario, the global spread of smartphones and apps has increased the options. (8-9-10). The traditional measurements supported by a paper ruler can bring precise data on length and width, but much less on the area, due to the morphologic irregularities that can be found in clinical practice. For this reason, traditional measurements can be easily con-

Table 1. Comparison between digital and traditional systems: ICC data for each measurement (32 total lesions).

	First Measurement	Second Measurement	Third Measurement	Total
Width (cm)	1.00	1.00	0.99	0.99
Length (cm)	0.98	1.00	1.00	0.99
Area (cm^2)	0.93	0.95	0.96	0.95

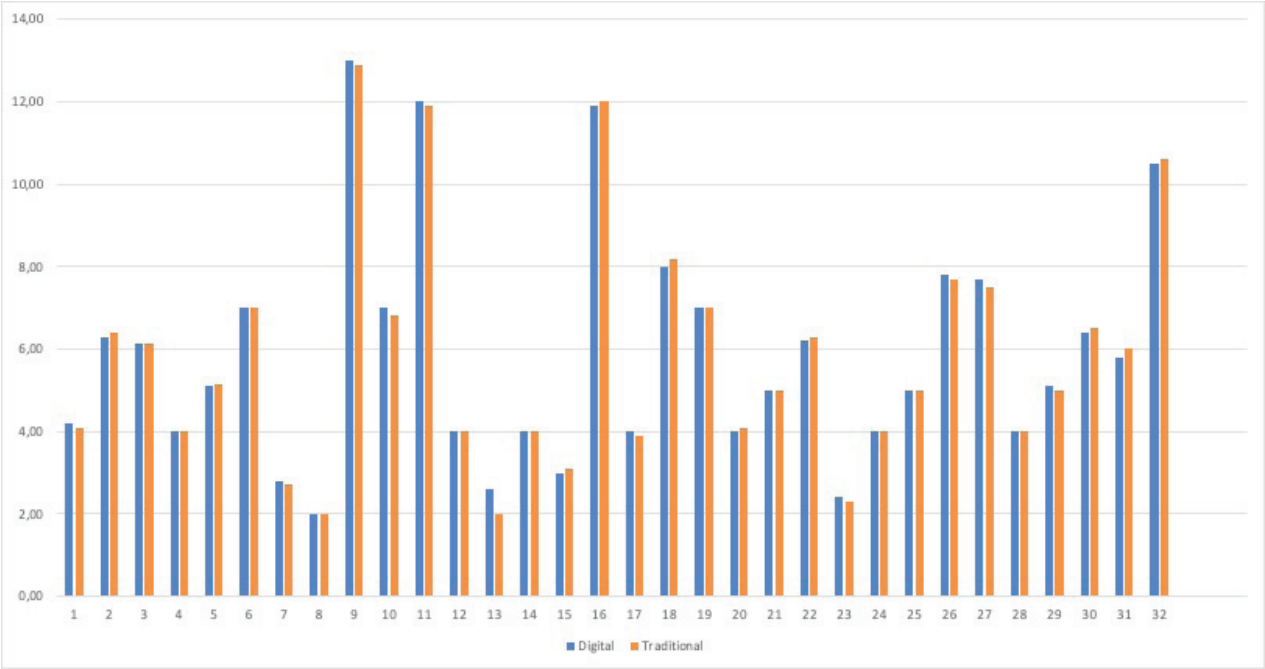

Figure 1. Wound areas, digital and traditional measurements (three measurements).

sidered less reliable when applied on irregular lesions.

Authors realized a pilot study focused on the statistical analysis of 32 cases of wounds measurements conducted by both the traditional method (paper ruler) both the digital smartphone analysis (with the app imitoMeasure ©). Three were the analyzed parameters: width (expressed in cm), length (expressed in cm) and area (expressed in cm^2). For each parameter, the statistical analysis showed that digital technology became highly reliable. The collected data, secondly, can be easily catalogued and reproduced. Authors must also focus on some limitations of this study, starting from the small number of enrolled patients and the relatively limited number of large lesions: this could have led to a lower percentage of discrepancies among the data. The digital measurement should be tested on several and different devices, in order to be considered homogeneous. Future studies should also define exclusion criteria for wound parameters that could influence the results, as well as the anatomic region. These characteristics can be considered the first step to increase the number of enrolled patients, for future evaluations.

Conclusion

This pilot study showed that the digital measuring systems should be easily addressed as versatile tools that could be applied in daily clinical practice in the future. Authors will conduct a long-time evaluation in order to confirm what found into this preliminary report.

Conflicts of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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Received: 27 December 2020
Accepted: 12 January 2021
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