Wound Areas by Computerized Planimetry of Digital Images: Accuracy and Reliability

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ABSTRACT

BACKGROUND: Tracking wound size is an essential part of treatment. Because a wound's initial size may affect apparent healing rates, its surface area (S) and its surface area-to-perimeter (S/P) ratio are useful to document healing. Assessments of these parameters can be made by computerized planimetry of digital images using suitable software.

OBJECTIVE: Because different caregivers often evaluate wounds and because measurement time is important, the objective of this study was to determine accuracy, repeatability, and measurement time of S and S/P from measurements of images recorded by digital photography.

METHODS: Six wound images of various complexities with known areas were measured in triplicate by 20 senior nursing students during 2 sessions 1 week apart. Images included an ellipse, 2 traced venous ulcers, and photographs of a pressure, diabetic plantar, and venous ulcer. Area error was determined as the percentage difference between known and planimetry measured areas. Reliability was assessed from test-retest coefficient of variations (CV%) from which the smallest meaningful percentage change (SMPC) was determined.

RESULTS: Area errors (mean $\pm$ SD) ranged from $-2.95\% \pm 7.01\%$ to $+2.32\% \pm 6.04\%$. For well-defined image margins, area and S/P SMPC values were all less than 3.2%. For borders that were not as well defined, SMPCs were larger, ranging between 6.2% and 10.8%. Wound measurement time decreased from 93.4 ± 35.1 seconds at session 1 to 67.7 ± 24.4 at session 2 ($P < .001$).

CONCLUSIONS: Results based on the specific software used and on the outcomes of the study group indicate that simple computer-based planimetry of digital images can provide rapid, accurate, and reliable estimates of wound area and S/P ratios.

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INTRODUCTION

Tracking and documenting changes in the patient's wound area are important parts of the overall treatment and assessment process.[1–9] Several methods have been used to estimate a wound's area, and some of them have been assessed with respect to their utility and reliability.[10–16] Some researchers have combined standard photography with transparency tracings,[15] whereas others have compared the use of video camera recordings with tracing methods.[17] Perhaps the simplest method is to measure wound length (L) and width (W) and to multiply these to get an estimate of area. Results obtained with this approach, when applied to diabetic wounds and venous ulcers in comparison to areas obtained using planimetry of wound tracings, showed overall agreement if a suitable multiplying constant was used in the area calculations.[18–20] However, significant individual differences between these L × W area determinations could occur principally related to wound shape and its change with treatment and time. This fact suggests that simple L × W measurements may be useful indicators under certain conditions,[21,22] but they are not suitable for situations in which more accurate assessments of area change are needed, such as to estimate healing rates.

When determining the rate at which a wound is healing, both the manner by which such a rate is calculated and the initial area of the wound may influence the calculated healing rate. For example, it has been reported that healing rates, calculated as change in wound area per day, were significantly and independently affected by the wound's initial area and other wound geometric factors.[5] In contrast, when the ratio of the wound's surface area (S) to its perimeter (P) was used as an index of healing, there was no dependence on initial wound area.[5] Several investigators have suggested that use of the S/P ratio is a useful method to characterize wound healing rates.[5,23–26] Changes in this parameter are a measure of the change in a wound's effective radius, which is an index of the movement of a wound's margin toward the center for healing or away from the center in the case of wound enlargement. Thus, if a wound were shaped like a circle, then twice the S/P ratio would be exactly equal to its radius. For other wound shapes, the S/P value can be viewed as an effective radius. The S/P ratio has been used to assess healing rates in venous ulcers and has been reported to be a suitable indicator of linear healing per day.[5,27] It has also been used to predict time to

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wound closure based on a nonlinear delayed exponential model of healing,[23,24] which seems to offer some predictive features.[25]

Whether wound healing progression is judged on changes in the absolute area, changes in the area relative to initial area, or changes in the S/P ratio depends on a suitably accurate and reliable method to determine the wound's area. The use of digital photography, which is now widely available for wound documentation, offers several benefits to other more complex methods. It can be done cheaply and quickly, and perhaps more important, it requires no contact with the wound bed in contrast to various wound-tracing methods. After obtaining the digital image, the wound area will need to be determined from the digitized image if it is going to be used for means other than simple visual documentation. Computerized planimetry can outline the margins of a wound, as depicted on the digitized image, on a computer screen, and automatically determine the enclosed area using a suitable software algorithm.

Because individual wounds are often treated and evaluated by different nurses, therapists, and other caregivers, it is important to have an estimate of the accuracy and reliability of this process. Although certain aspects of this question have been studied by determining intrarater and interrater reliability of various methods,[1,10,12,14,16,17,28] most studies have used only a few raters, thereby limiting the ability to generalize the results. Furthermore, few studies have addressed the issue of absolute accuracy. A notable exception is a study in which a group of nurses and student nurses evaluated 3 differently shaped plaster-of-paris wound models of known area.[14] Models were measured by several methods, including directly measured L × W of the model, planimetry of tracings of the model, and computerized stereophotogrammetry using a commercial system. It was reported that the smallest measurement error resulted with the computerized area determination and that only this method had a sufficiently high single-tester reliability to justify its use for clinical measurements. However, the reported percentage error, even with the clearly defined margins of the models used, was 14.9% in the best case using the stereophotogrammetry system for area determinations.

The goal of the present study was to focus on both accuracy and reliability issues associated with using simple digital photography combined with computerized planimetry. The study used a group of 20 nursing students as raters, who performed computerized area determination tasks on 6 differently shaped images that had known areas. The goal of this research was to determine the accuracy and repeatability of area measurements achieved by this representative group of student nurses who were at the time 6 months from graduation.

METHODS

Participants

The group consisted of 20 nursing students who were in their senior year of a 4-year bachelor of science in nursing program at Nova Southeastern University, Ft Lauderdale, Florida.

Images

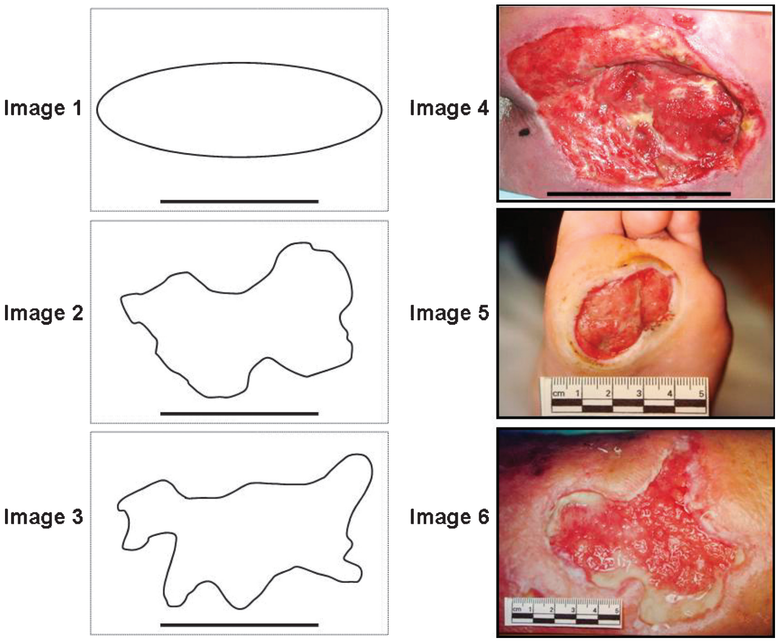
Six test images of various complexities having areas known to within ± 0.15 cm^2, as determined by methods described in the next section, were subsequently measured in triplicate by planimetric methods by the 20 student nurses during 2 sessions, 1 week apart. Images (Figure 1) included an ellipse (image 1), 2 traced venous ulcers (images 2 and 3), photographs of a sacral pressure ulcer (image 4), a diabetic plantar ulcer (image 5), and a venous leg ulcer (image 6). To obtain test images 1 through 3, the shapes and the horizontal calibration bars were drawn with a computer and then printed on heavy photographic paper. To obtain test images 4 through 6, a calibration bar was placed on a photograph of the ulcers and then printed. All 6 printed images with their embedded calibration bars were then photographed with a digital camera (Sony Cyber-shot) at a resolution of 1024 × 768 pixels. The calibration bars would subsequently be used by the raters to calibrate the linear dimensions of the images for area determinations using the area software. Lengths of the calibration bars were verified with a micrometer accurate to ± 0.1 mm. Photographs were taken with a 90-degree angle between the camera's line of sight and the plane of the image being photographed. The physical distance of the camera image sensor to the target was about 30 cm, and the camera's zoom was used if necessary to render the captured image, including the embedded calibration marker, to occupy at least 75% of the available viewing area.

Image Areas

Using a scalpel, the entire perimeter margin of each shape was carefully scored to produce a cutout of the target shape inside area. The shapes were then weighed on a scale accurate to 0.0001 g. To determine actual areas, weight (Wi) of each target shape was compared with a computer-generated and drawn square of known area (A_K) that was printed on the same paper as the target shape. The square was cut out from the paper, and its weight (W_K) was determined in the same way as the target shape. Areas (Ai) were determined as $Ai = (Wi / W_K) \times A_K$. Weight measurements were done in triplicate, and the average value was used for the calculation. To test the accuracy of the weight method for determining areas, a series of circular shapes with areas spanning the range of the target images were computer drawn, printed, and then cut out in the exact manner as the target images. The weight-determined areas were then

Figure 1.
TEST IMAGES

Image 1 is an ellipse; images 2 and 3 are traced venous ulcers; images 4 through 6 are, respectively, photographs of a sacral pressure ulcer, a diabetic plantar ulcer, and a venous leg ulcer. Calibration bars for images 1 through 4 are 10 cm, and scale length for images 5 and 6 is 5 cm. Areas and shape factors of each image are shown in Table 2.



compared with calculated areas for each circular shape (calculated-measured) as shown in Table 1. Absolute error ranged from −0.017 cm^2 for the smallest area to 0.351 cm^2 for the largest area; calculated percentage errors ranged from −0.66% to +0.32%. Based on the data of Table 1, the authors concluded that weight-determined areas estimate image areas of 10 cm^2 or larger with percentage errors not greater than 0.32% and by percentage errors not greater than 0.66% for image areas less than 10 cm^2. Weight-determined areas for target images 1 through 6 were, respectively, 84.0, 87.0, 86.7, 81.4, 6.47, and 41.0 cm^2.

Weight-determined areas for all images are taken as actual areas for analytical comparisons of student measurement accuracy that will be discussed later in this article.

Table 1.

WEIGHT-DETERMINED AREAS FOR CIRCULAR CALIBRATION SHAPES

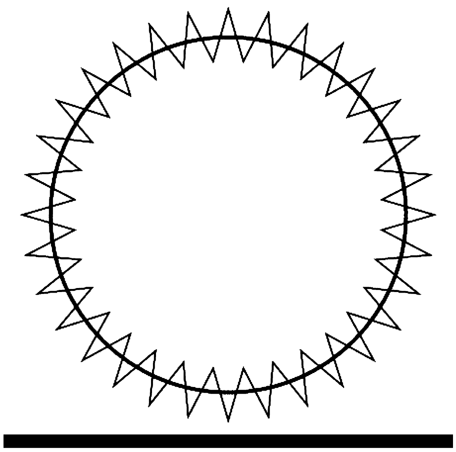
Area Calculated, cm^2	Area by Weight			
	Weight, g	Area, cm^2	Error, cm^2	Error, %
119.97	2.7855	119.62	0.351	0.29
79.95	1.8557	79.69	0.259	0.32
40.04	0.9316	40.01	0.028	0.07
10.20	0.2367	10.17	0.031	0.30
5.06	0.1183	5.08	−0.025	−0.50
2.54	0.0596	2.56	−0.017	−0.66

Shape Factors

One reason for using shapes of similar absolute area for images 1 through 3 was that it would then be possible to determine the extent to which the shape factor (SF) affected the accuracy and reliability of the area determinations. The SF is a parameter defined by the relationship SF = $4\pi S / P^2$, in which S and P are surface area and perimeter, respectively.[16] If 2 shapes have equal areas, then the SF is an index of the amount of smoothness of the shape's perimeter. This concept may be visualized in Figure 2, which shows 2 shapes: one is a pure circle with a smooth margin, and the other a circular-like shape with a sawtooth-like margin. Both margins enclose exactly the same area (70.8 cm^2). The SF of the pure circle is 1.0. Any other shape with the same enclosed area will have an SF of less than 1.0. If the circle's perimeter were ''wiggly'' as shown in the figure, rather than smooth, its SF would be much

Figure 2.
SHAPE FACTOR

Shape factor is defined by the relationship SF = $4\pi S / P^2$, in which S and P are surface area and perimeter, respectively. The SF is an index of the amount of smoothness of the shape's perimeter. The 2 shapes shown have equal areas (70.8 cm^2), but the SF is 1.0 for the pure circle and 0.118 for the irregular margin.



less than 1.0. In the extreme example shown, the SF of the wiggly area is 0.118. An ellipse's SF depends on the ratio of its major axis dimension (L) to its minor axis dimension (W): SF = 2 (W / L) / [(W / L) 2 + 1].[16] For test image 1, which has a W / L = 1/3, this corresponds to an SF = 0.600. For images 2 and 3, the corresponding SFs are 0.571 and 0.395, respectively. SFs for ulcer images 4, 5, and 6 were approximately 0.792, 0.773, and 0.442, respectively. The approximate SFs for images 2 through 6 were determined by dividing the areas as determined by weight by the square of the perimeter as determined by planimetry.

PROCEDURES

Before beginning the measuring protocol, all 20 students received a 15-minute introduction by the lead author to the tasks they would need to perform. They also were shown each image once on a computer screen. The students were instructed to trace the shapes as if they were actually documenting a patient's wound. To familiarize them with the operation of the software they would subsequently be using, the lead author demonstrated a planimetry tracing procedure on image 1. The software used was a modified version of an inexpensive commercially available wound area determination program (WoundAreas Professional; Biomedical Consultants Group, Gainesville, Florida; http://www.bimeco.org). The modification was that the normally visible values that would be shown for wound areas and perimeters were electronically masked. Thus, the student had no knowledge of the values that were obtained.

During the measurement procedure, the student would display the first image (image 1) on the computer screen and then calibrate the horizontal dimension using the embedded calibration bar or scale. The calibration procedure was quite simple. It required that the rater only place the mouse cross hair over 2 separated points on the calibration bar and click the mouse. The points for each image were standardized, being at the beginning and end of the bars for images 1 through 4 and at the 0- and 5-cm marks for images 5 and 6. Next, the student would trace the image 3 times in succession using a mouse. After 3 tracings, the software instructed the student to load the next image (image 2) and so on until all 6 images had been traced 3 times. The student needed to calibrate each time a new image was loaded using the embedded calibration bar, which was 10 cm in length for images 1 through 4 and 5 cm for images 5 and 6. For each tracing, each value obtained for area, perimeter, calibration factor, and the time to complete was captured and stored for later analysis by the principal investigator. The order of analyzing the images was 1 through 6 for all raters. The above procedures were repeated by each student 1 week later as a retest factor.

ANALYSIS

Accuracy

The authors define error attributable to the full planimetry procedure as the difference between each image's area, as determined by its weight and the image's area as determined by the planimetry method: error = (weight − determined area − area determined by planimetry). The planimetry-determined area was the average of the 3 tracings for each image. Sources of potential error in the full planimetry procedure include the calibration, the selection of the margin to be traced, and the actual tracing procedure. For images 1 through 3, the margin was well defined, so it was anticipated that margin identification would not be a major factor. In contrast, for images 4 through 6, a judgment was needed to determine what constituted the margin to be traced. This decision was left to the student rater. Percentage errors along with associated SDs were determined for the entire sample for each image.

Reliability

Interrater reliability or precision is simply the extent to which the different students, who have used the same measurement tool and process, get equal measurement values. Precision of measurements among students was determined and is reported based on the coefficient of variation (CV%) of S values obtained for each image. The CV% was calculated as the SD of values obtained among students divided by the mean: CV% = 100 × (SD / mean). First- and second-week values of CV% were calculated separately.

Intrarater reliability or repeatability in the present context is the extent to which student raters replicated the measured values on the 2 separate occasions. The lower the repeatability, the greater the amount of change that must occur to confidently accept a change as real. This minimum amount of change is calculable from the method error (ME),[29] which can be expressed as $ME = SD_{diff} / \sqrt{2}$, in which SD_{diff} is the SD of differences between the 2 separate measurement sessions.[30] A group test-retest coefficient of variation (CV_{12}%) that includes both sessions 1 and 2 measurements can then be determined as $CV_{12}\% = 100 \times (ME / M_{12})$ in which M_{12} is the overall mean value of sessions 1 and 2 measurements. The utility of CV_{12}% is that, in 95% of paired repeated measurements, the percentage difference between the values obtained is expected to be less than $1.96\sqrt{2}$ CV_{12}%.[31] From a practical point of view, this implies that if measurements are made by any rater on the first session and made by any different rater on the second session, then the smallest meaningful percentage change (SMPC) needs to be greater than 2.77 CV_{12}%. SMPC is determined for both S and S/P.

An alternative, but less robust, approach is to consider differences in values obtained by the same rater at the 2 different measurement sessions. To provide such a comparative estimate, the percentage differences between area values obtained on the first and second sessions for each image and rater were determined, and the average among raters was calculated.

Shape Factor Dependence

SF dependence was analyzed by determining if there was a significant correlation between the SMPC and the SF. This was done by linear regression analysis of SMPC on SF, with a significance level of <.05 taken as significant.

Time Factors

Time factors were analyzed based on the time to complete each image measurement procedure during session 1 (T1) and during session 2 (T2). T1 and T2 were determined as the average of the 3 measurements done for each image at each session. Questions of whether there was a change in measurement time with session and whether measurement time depended on image were analyzed using a general linear model for repeated measures, with time as the repeated measure.

RESULTS

Accuracy results using the digital planimetry method are summarized in Table 2. The main result shows that the mean area error is less than 3% for all images of both test sessions. The larger errors, and those having the larger SDs, are those associated with measurements of the plantar and venous ulcer photographic images. For the venous ulcer, the mean area determined by planimetry is slightly greater than the weight-determined area, whereas for the plantar ulcer, the mean planimetry area is slightly less than the weight-determined area. Paired *t* tests for possible differences between sessions in planimetry-determined areas and for area errors show these to be not significant for any image ($P > .2$). Combining first- and second-session errors yields the overall combined percent area errors listed in the last column of the table. This area error shows no defined relationship to either SF ($P > .5$) or absolute value of the various areas ($P > .5$).

Repeatability results for area, perimeter, and calibration factor measurements are summarized in Table 3. For areas and perimeters, the CV% among raters were similar for both test sessions and were less than 2.5% for images 1 through 4. Measurements of the plantar and venous ulcer photographic image yielded the largest variation among raters, with the largest variation associated with the plantar ulcer, which was the smallest of the areas measured. Area CV% for these 2 images ranged from 6.72% to 7.56% over both measurement

Table 2.
AREA PARAMETERS AND MEASUREMENT ACCURACY ESTIMATES

Image	SF	Area (S) by Weight, cm^2	Area (S) by Planimetry, cm^2		Area Error, %		
			Test 1	Test 2	Test 1	Test 2	Combined
(1) Ellipse	0.600	84.0 ± 1.0%	83.5 ± 2.1	83.4 ± 1.9	0.31 ± 2.50	0.75 ± 2.30	0.53 ± 2.38
(2) Venous ulcer	0.571	87.0 ± 0.15	85.4 ± 1.2	84.9 ± 1.9	1.87 ± 1.41	2.44 ± 2.24	2.16 ± 1.87
(3) Venous ulcer	0.395	86.7 ± 0.15	86.4 ± 1.7	86.0 ± 1.1	0.33 ± 1.96	0.75 ± 1.27	0.54 ± 1.64
(4) Sacral ulcer	0.792	81.4 ± 0.15	81.4 ± 1.3	81.9 ± 1.8	0.01 ± 1.55	−0.53 ± 2.21	−0.28 ± 1.90
(5) Plantar ulcer	0.773	6.47 ± 0.15	6.38 ± 0.29	6.26 ± 0.47	1.40 ± 4.43	3.25 ± 7.31	2.32 ± 6.04
(6) Venous ulcer	0.442	41.0 ± 0.15	42.5 ± 2.9	41.9 ± 2.9	−3.80 ± 6.98	−2.11 ± 7.12	−2.95 ± 7.01

Planimetry values are mean ± SD. SF is the shape factor of the measured area. Tests 1 and 2 data are for values obtained 1 week apart. Neither planimetry areas nor errors differed significantly between tests 1 and 2. Data in the column labeled "Combined" include tests 1 and 2 errors.

Table 3.

REPEATABILITY ESTIMATES

Image	Area CV%		Perimeter CV%		Calibration Factor CV%		SMPC = 2.77 CV_{12}%		%Diff
	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2	Area (S)	S/P	
(1) Ellipse	1.50	1.81	1.33	1.48	0.30	0.65	2.51	2.45	0.02 ± 3.38
(2) Venous ulcer	1.44	2.30	2.01	2.07	0.57	0.79	2.52	2.51	0.42 ± 1.78
(3) Venous ulcer	1.96	1.28	1.72	2.14	0.64	0.67	2.42	2.35	0.26 ± 1.94
(4) Sacral ulcer	1.55	2.20	2.47	2.41	0.31	0.42	2.62	3.17	0.24 ± 1.63
(5) Plantar ulcer	7.49	7.56	4.26	3.90	0.56	0.60	10.79	10.05	0.15 ± 3.48
(6) Venous ulcer	6.72	6.98	2.43	2.64	0.82	0.80	7.14	6.25	1.31 ± 4.82

Area, perimeter, and calibration factor coefficients of variation (CV%) show variability of measurements among students for each test session. SMPC is the smallest meaningful percentage change based on the test-retest variability (CV_{12}%). %Diff is the mean ± SD of individual rater percentage differences in area measurements between tests 1 and 2.

sessions. Test-retest variability (CV_{12}%) was also greatest for these 2 images, resulting in their SMPC ranging from 6.25% to 10.8% for area and S/P determinations. The CV% for all calibration factor determinations was less than 1%. Percentage differences in area values obtained by the same raters during tests 1 and 2 are shown in the last column of Table 3. The results show that, for this estimate, mean percentage differences for all images other than image 6 are less than 1%.

Results of time factor analyses are summarized in Table 4. During test session 2, measurement times were all less than those during session 1 (P = .004), with the overall average time being reduced from 93.4 ± 35.1 seconds for the first session to 67.7 ± 24.4 seconds for the second session (P < .001). Measurement times ranged from 44.7 ± 9.1 seconds for the plantar ulcer to 81.1 ± 28.5 seconds for a venous ulcer image. This time reduction was independent of image as there was no time-image interaction (P = .720). Among the images for both sessions, measurement time for image 5 was significantly less than for images 2, 3, and 4 (P < .01). There was a significant correlation between sessions 1 and 2 measurement times (r = 0.603, P < .01) and between sessions 1 and 2 measurement errors (r = 0.607, P < .01), but there was no significant relationship between measurement time and measurement error.

Table 4.

MEASUREMENT TIMES

Image	Measurement Time, s	
	Test 1	Test 2
(1) Ellipse	99.5 ± 37.1	65.4 ± 26.7*
(2) Venous ulcer	106.3 ± 39.9	73.3 ± 19.9*
(3) Venous ulcer	103.8 ± 26.1	81.1 ± 28.5*
(4) Sacral ulcer	102.6 ± 36.6	77.2 ± 23.8*
(5) Plantar ulcer	65.0 ± 24.7†	44.7 ± 9.1*†
(6) Venous ulcer	83.2 ± 30.9	64.5 ± 19.3*
Overall average	93.4 ± 35.1	67.7 ± 24.4‡

Entries are the mean ± SD time (in seconds) to complete a single area measurement procedure.
*Significantly less than for test 1 (P = .004).
†Measurement time for image 5 was significantly less than for images 2, 3, and 4 during both tests (P < .01).
‡Significantly less than for test 1 (P < .001).

DISCUSSION

One new result of the present study relates to the characterization of expected errors when using simple digital planimetry of photographic images to assess wound area. In this study, all of the raters measured all of the wounds in the same order on both occasions. It was found that mean area measurement error achieved by the test group of 20 raters for all images was less than 4% at each test session and was less than 3% for combined sessions. Although this error level may be acceptably small for most clinical applications, it is instructive to consider briefly possible sources of error. One possible error source is that associated with the estimate of the weight-determined "gold-standard." As noted in the Methods section, the weight-determined percentage errors ranged from −0.66% to +0.32% and are therefore not a significant source of error. Other factors potentially contributing to the student measurement process error include the image calibration, the identification of the image or wound margins, and the actual tracing process. As demonstrated in Table 1, the CV% for the calibration factor was less than 1% for all images so that the remaining small error is due to a combination of identifying the wound margins and the actual tracing procedure. The present data set does not allow for separating out these components.

A second new finding was related to the repeatability of digital planimetry for the assessment of S and the S/P parameter. Here, the most important result was the determination of the SMPC in area. This parameter ranged from about 2.5% to almost 11%, depending on the specific image being measured. Originally, it was thought that the SMPC would be related to the complexity of the wound margin as characterized by its SF. This proved not to be true as evidenced by nonsignificant correlations (P > .5) between SMPC and SF for both area and S/P determinations when SMPC and SF were subjected to regression analyses. A close examination of each image's features suggests that a more important aspect is the level of ambiguity with which the wound margin could be determined. For the ellipse, the 2 drawn venous ulcers, and for the sacral ulcer image, the location of the margin was well defined. Measurements of these resulted in the lowest SMPC, with area SMPC values tightly distributed between 2.42% and 2.62%. In contrast, measurement of the plantar and venous ulcer photographic images required the students to make judgments as to what constituted the actual wound margin. Measurements of these images resulted in considerably larger SMPC values. Consequently, the authors suspect that the largest source of variability, and therefore the main determinant of a wound-specific SMPC, is the ambiguity of the wound margin selection among evaluators. The percentage difference in area values obtained by the same raters on the 2 separate evaluation sessions (Table 3) suggests that better repeatability results for more complex wound margins would be obtained when the same rater evaluated the wounds on both occasions.

The present study results apply strictly to the outcomes achieved using the software algorithms used and to the specific group of raters who participated. Although all the raters had been trained in the principles of wound care and completed rotations through wound care–related clinics, their wound care experience was limited. Thus, the goal to include a large enough sample to provide a reasonable generalization of study results was probably only partially met, in the sense that the results generalize to student nurses with similar training. It would be expected that, at least for those measurements associated with the less-defined wound margins, more experienced wound care specialists would achieve as good an outcome. An investigation into this aspect requires further research.

CONCLUSIONS

Pressure ulcers are a significant problem in hospitalized patients, as well as in those receiving treatment in skilled nursing facilities and home healthcare settings. Nurses and therapists in various areas of practice encounter patients with wounds of various types, shapes, and sizes. Throughout entry-level (prelicensure) and other programs, students are provided with content regarding the care of patients with alterations in skin integrity, including those with wounds. Careful and accurate assessment is stressed as an essential component to treatment decisions and modifications. It is emphasized that information obtained during baseline and ongoing assessments of a wound provides the healthcare team with data on which the progression or regression of wound healing can be closely monitored. Because multiple members of the healthcare team may be involved in assessing a wound for change over time, the need for an objective means of assessment is substantially increased. For the first-line professional involved in wound assessments, it is beneficial to have a means to objectify and report assessment data. Clear, understandable, relevant, and comprehensive documentation helps to ensure continuity and ultimately better patient outcomes.

The results of this study, compiled in a limited sample, support the use of computerized planimetry software as an objective method for the ongoing assessment of wounds in clinical practice. Repeatability results and interrater reliability support the clinical applicability when multiple practitioners are required to assess the wounds of a given patient. Further research is warranted using graduate nurses, as well as certified wound care specialists.

In summary, the study suggests that computerized planimetry of digitized wound photographs using the present software is an accurate and reliable way to measure and document wound areas and an associated wound closure parameter, defined as the ratio of wound surface area to perimeter.

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