Alternative 3D Wound Measurement Device for Monitoring Wound Area

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Introduction:

The measurement of wound size is a key component of chronic wound care.[1,2] Wound size reduction is considered the best method to objectively assess healing and provides critically important prognostic information, yet our current techniques of measurement are imprecise and inaccurate.[3,4] Hand measurements, which typically measure orthogonal length and width, are subject to inaccuracy due to irregular borders, user variability, and other factors.[5] New products, such as laser-assisted medical wound measurement (LAWM) devices provide more accurate measurements but are cumbersome and require significant time.[6] The eKare device is a mobile 3D wound measurement device attached to an iPad.[7] It has a friendly user interface and an infrared assisted camera that can assess both wound area and volume. In this study, we compare three modalities in wound area measurements: the eKare device, the ARANZ Silhouette Star (a LAWM device), and standard hand measurements.

Methods:

Patients were considered eligible for this study if they were above 18, were willing to participate and gave consent, and did not have a circumferential wound. Trained researchers at the University of Miami conducted this trial. Wounds were measured for area by orthogonal length and width using a ruler, using the eKare device, and using the ARANZ Silhouette Star. If debridement of the wound was considered necessary for care, measurements were taken after debridement. IBM's SPSS Statistics was used for analysis and for paired t-testing to determine statistical significance.

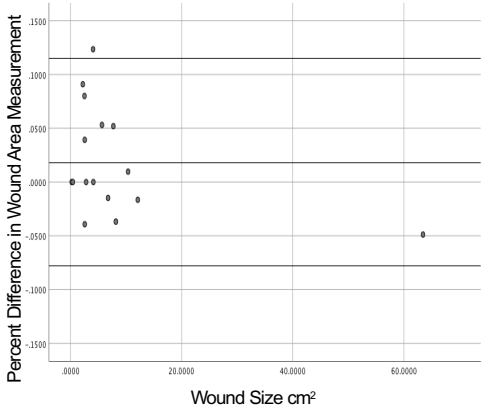
Table 1: Measurements

Wound Number	Hand Length (cm)	Hand width (cm)	Hand area (cm^2)	eKare (cm^2)	Silhouette (cm^2)
1	1.9	1.5	2.85	2.3	2.1
2	6.25	2.7	16.875	12	12.2
3	4.6	3.1	14.26	7.9	7.5
4	4	2.9	11.6	8	8.3
5	4	2.1	8.4	6.7	6.8
6	9.8	10.3	100.94	61.9	65
7	3.6	2.2	7.92	5.8	5.5
8	0.4	0.7	0.28	0.2	0.2
9	2.1	2.1	4.41	2.6	2.4
10	1.1	0.6	0.66	0.4	0.4
11	2.2	1.6	3.52	2.8	2.8
12	2.5	3.2	8	2.6	2.5
13	2	1.8	3.6	2.5	2.6
14	5.75	2.9	16.675	10.4	10.3
15	3.6	1.5	5.4	4.3	3.8
16	3.3	2.1	6.93	4.1	4.1

Table 2: Statistical Comparison of Measurements

	Average absolute difference in wound area	Average absolute percent difference in wound area	Statistical Significance
Including Outlier			
eKare vs ARANZ Devices	0.35cm^2	3.78%	**p = 0.552**
eKare vs Hand Measurements	4.86cm^2	33.49%	**p = 0.040**
ARANZ vs Hand Measurements	4.74cm^2	34.64%	**p = 0.043**
Excluding Outlier			
eKare vs ARANZ Devices	0.17cm^2	3.70%	**p = 0.215**
eKare vs Hand Measurements	2.58cm^2	33.15%	**p < 0.001**
ARANZ vs Hand Measurements	2.65cm^2	34.58%	**p < 0.001**

eKare vs ARANZ: Bland-Altman Plot



Results:

Sixteen unique wounds of various etiologies were included in this study from a total of 13 patients. The average absolute difference in wound area measurement between the eKare device and the ARANZ device was 0.35cm^2. Taking into consideration the total area of the wounds, this accounted for an average of 3.78% difference in wound area measurements. In contrast, the average absolute difference in area between the eKare device and hand measurements was 4.86cm^2 accounting for a 33.49% percent difference. The average absolute difference between hand measurements and the ARANZ camera was 4.74cm^2 accounting for a 34.64% difference. Using paired t-tests, there was no statistically significant difference in measured area between the eKare device and the ARANZ camera ($p = 0.552$). There were statistically significant differences in area with both the eKare device and the ARANZ device in comparison to hand measurements ($p = 0.040$ and $p = 0.043$ respectively).

One wound was significantly larger than the others (wound 6), leading to some concern of an outlier bias. With this outlier removed, the difference in area measured between the eKare device and the ARANZ was still not statistically significant ($p = 0.215$). Hand measurements significantly differed from the measured areas of both the eKare and ARANZ devices ($p < 0.001$).

Example eKare Device Measurement

Conclusions:

- There was no statistically significant difference between the area measurements of the eKare device in comparison to the ARANZ device.
- There was a statistically significant difference between the eKare and ARANZ device area measurements in comparison to hand measurements.
- After removal of an outlier, results continued to demonstrate no statistically significant difference in area measurements between the eKare and ARANZ devices
- The area measurements of the eKare device appear to be comparable to laser-assisted wound measurement devices, making it an option for clinicians and researchers interested in monitoring wound progression.
- Clinical experience indicates the eKare device has a friendly user interface, a convenient portable design, and can take quick wound-area measurements; however, the device cannot measure circumferential wounds

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