Original Investigation

Frequency of Debridements and Time to Heal
A Retrospective Cohort Study of 312 744 Wounds

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Invited Commentary

IMPORTANCE Chronic wounds usually get trapped in the inflammatory stage of wound healing; however, aggressive debridement transforms chronic wounds to acute wounds and therefore complete healing.

OBJECTIVE To investigate healing outcomes and debridement frequency in a large wound data set.

DESIGN Retrospective cohort study.

SETTING Data collected from 525 wound care centers from June 1, 2008, through June 31, 2012, using a web-based clinical management system.

PATIENTS Referred sample of 154 644 patients with 312 744 wounds of all causes (of an initial data set of 364 534 wounds) participated. A total of 47.1% were male. Median age was 69 years (age range, 19-112 years), with 59.2% having one wound. Eligibility criteria included age older than 18 years, receiving at least 1 debridement, and having been discharged from the system. Advanced therapeutic treatment was ineligible. Because of incomplete, questionable, or ineligible data, 57 190 wounds were not included. Most wounds were diabetic foot ulcers (19.0%), venous leg ulcers (26.1%), and pressure ulcers (16.2%).

INTERVENTION Debridement (removal of necrotic tissue and foreign bodies from the wound) at different frequencies.

MAIN OUTCOME AND MEASURE Wound healing (completely epithelialized with dimensions at 0 × 0 × 0 cm).

RESULTS A total of 70.8% of wounds healed. The median number of debridements was 2 (range, 1-138). Frequent debridement healed more wounds in a shorter time ($P < .001$). In regression analysis, significant variables included male sex, physician category, wound type, increased patient age, and increased wound age, area, and depth. The odds ratio varied considerably for each variable.

CONCLUSIONS AND RELEVANCE The more frequent the debridements, the better the healing outcome. Although limited by retrospective data, this study's strength was the analysis of the largest wound data set to date.

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Debridement is the key process of wound bed preparation or "the global management of the wound to accelerate endogenous healing or to facilitate the effectiveness of other therapeutic measures"[1(p1)] in wound care. It is the removal of necrotic tissue, bacteria, and other foreign bodies from the wound and is more generally defined as the removal of dead cells.[2-4]

When a wound is debrided, platelets occupy the wound space to begin clotting to control hemorrhaging, initiating the first stage of wound healing, the inflammatory phase.[3] In the first 48 hours, healing is managed by platelet-derived growth factors (PDGFs) and transforming growth factors. Once circulating monocytes become tissue macrophages, they supply the key multiple growth factors for healing.[3] A long-term wound gets trapped usually in the inflammatory stage, but aggressive debridement transforms it to an acute wound and therefore complete healing.[5]

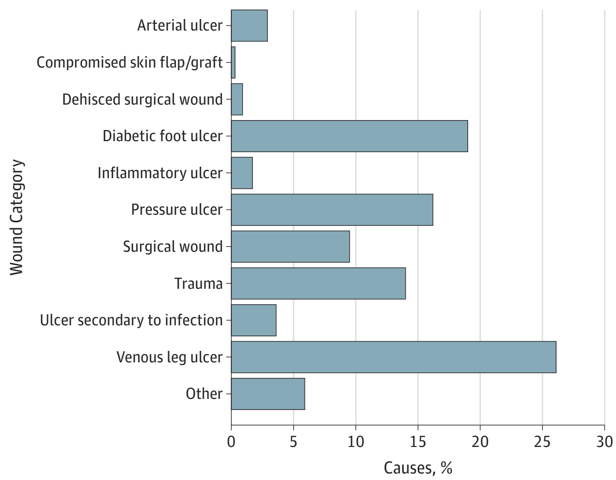
There are 5 debridement techniques: autolytic, enzymatic, mechanical, surgical, and biosurgical debridement.[2,3,6] Autolytic debridement is when the body breaks down the necrotic tissue with its own defense mechanisms.[2,6] Enzymatic debridement applies enzymatic agents to break down the tissue within the wound only (not the surrounding area).[3] Mechanical debridement can consist of wet-to-dry dressing application on the wound, pulsed lavage, whirlpool therapy, and/or the surgical removal of the dead tissue.[2,3] Wet-to-dry dressings can be painful and cause bleeding, whereas pulsed lavage is painless and can be easily performed by nurses.

Limited research on the efficacy of debridement has been conducted to date.[3,5] Steed and colleagues[7] performed the most compelling study, a randomized, prospective, double-blinded trial of PDGF therapy in diabetic foot ulcers (DFUs), which found a direct association between the incidence of debridement (weekly sessions) and healing rate in both the treated and control groups. Debridement frequency and healing outcomes are covered in a report by Saap and Falanga,[8] who developed the Debridement Performance Index and analyzed retrospective data from a pivotal trial of bioengineered tissue for DFUs. They found that healing was twice as likely with aggressive debridement. This finding was further supported by another study[9] on sharp debridement with a curette in an outpatient setting. Finally, a study[10] concluded that frequent debridement of DFUs and venous leg ulcers (VLUs) may improve healing outcomes. The goal of this study was to investigate the association between healing outcomes and debridement frequency in a large wound data set, examining all wound causes.

Methods

This was a retrospective cohort study of 154 664 patients with 312 744 wounds of all causes in regard to debridement patterns. Data were collected from June 1, 2008, through June 31, 2012, from 525 wound care centers. All patients signed consent forms to permit inclusion in the study, and all procedures were conducted in accord with the ethical standards of the Declaration of Helsinki.

Figure 1. Categories of Wound Causes Used in the Analysis



To be eligible for the study, a patient had to be older than 18 years, had to have received at least 1 debridement for a wound, and must have been discharged from the system. Any wound that received advanced therapeutic treatment above what was considered standard care was excluded from the study (eg, skin graft [Apligraf] for a VLU or hyperbaric oxygen for a DFU).

Database Extraction

Data were obtained from the i-heal (Healogics) proprietary clinical management system, a leading web-based outcomes management and tracking database for clinical status, use, surveillance, and financial outcomes.[11] Nurses and physicians document visits at the point of care for parameters on paper-based forms. At the end of the workday, they enter the data into the i-heal database. Although no specific data integrity check is undertaken, if data for the highlighted items are not entered, the record for each visit cannot be completed. Thus, missing data are avoided. Deidentified data were extracted from the i-heal database using SQL software (Relational Software Inc) and entered into an Excel spreadsheet so that no patient identifiers were present.

Preparation of Study Database

The initial data set included 364 534 wounds. After examining the data for each variable in SPSS PASW statistical software, version 19 (SPSS Inc), 16 448 cases were deleted because of nonnumerical entries for patient wound numbers, leaving 348 586 cases to be analyzed. There were 1021 cases with initial wound areas larger than 500 cm^2 (many were burns), which were deleted, leaving 347 565 cases to be analyzed. The log initial area was then computed. By examining graphs, it was determined that a substantial number of cases had a noncomputable log (ie, equivalent to 0). These 1604 cases were deleted, leaving 345 961 cases to be analyzed. Forty-six patients and their associated single wounds had no sex assigned, and these cases were deleted, leaving 345 915 cases to be analyzed. In regard to patient age, there

Table 1. Baseline Characteristics of the Different Wound Types[a]

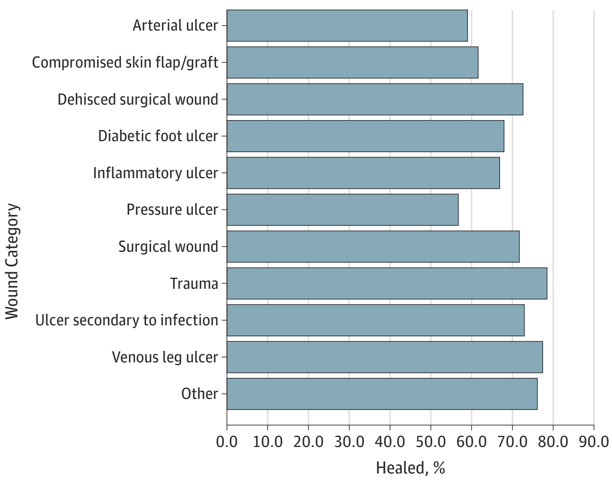
Characteristic	Arterial Ulcer (n=9067)	Compromised Skin Flap/Graft (n=812)	Dehisced Surgical Wound (n=2887)	Diabetic Foot Ulcer (n=59 464)	Inflammatory Ulcer (n=5173)	Pressure Ulcer (n=50 593)	Surgical Wound (n=29 721)	Trauma (n=43 887)	Ulcer Secondary to Infection (n=11 277)	Venous Leg Ulcer (n=81 560)	Other (n=18 303)
Wagner grade											
1				32.70							
2				45.10							
3				18.00							
Nongradeable or unknown				4.20							
Stage											
Unstageable						8.10					
I						4.80					
II						38.40					
III						36.10					
IV						12.60					
Area, cm^2											
Median	1.60	2.80	2.70	1.35	1.80	2.34	2.88	2.85	1.50	2.32	2.32
<1.0	40.70	30.90	31.90	44.70	38.80	34.10	31.10	28.50	42.20	32.60	23.70
1.01-5.0	33.90	29.90	30.70	32.00	31.80	32.00	30.30	34.90	31.70	33.70	30.40
5.01-20.0	16.90	22.40	22.90	16.70	17.90	23.20	22.80	24.60	16.30	20.00	24.10
20.01-100.0	7.00	15.00	12.90	5.90	8.60	9.90	13.30	10.60	7.70	10.60	15.50
>100.0	1.90	1.70	1.60	0.80	2.90	0.80	2.50	1.50	2.10	3.00	6.30
Depth, cm											
Median	0.10	0.30	0.50	0.10	0.10	0.20	0.50	0.10	0.20	0.10	0.10
≤0.25	81.00	48.30	32.20	72.80	76.80	68.10	37.10	79.40	59.30	87.10	83.30
0.26-0.50	14.80	21.80	18.40	17.20	14.30	13.90	18.00	12.40	16.20	10.40	9.40
0.51-1.0	3.00	8.90	14.80	6.10	5.10	6.50	13.10	4.90	10.80	1.80	3.50
1.01-2.0	0.90	11.20	13.80	2.90	2.70	5.90	14.20	2.50	8.40	0.50	2.10
>2.0	0.40	9.90	20.80	1.00	1.10	5.60	17.60	0.80	5.20	0.10	1.60
Age, d											
Median	30.00	36.00	24.00	21.00	21.00	24.00	22.00	12.00	15.00	17.00	10.00
<50	62.80	61.10	72.40	70.00	66.40	67.40	73.60	85.40	76.50	70.80	82.80
51-99	17.00	17.30	14.90	13.00	14.30	14.50	13.80	8.60	10.20	12.30	7.60
100-199	10.60	9.70	6.50	8.20	9.30	8.90	6.60	3.40	6.50	7.50	4.20
200-999	8.20	8.80	5.10	7.40	7.30	7.60	4.90	2.10	5.50	2.00	4.00
≥1000	1.40	3.10	1.20	1.40	2.80	1.60	1.20	0.40	1.20	7.20	1.40

[a] All data except for median are presented as percentages.

were 11 wounds associated with no patient age, 2049 wounds that were associated with a negative patient age, 4948 wounds associated with patients whose age was 0 to 18 years, and 5 wounds associated with a patient aged older than 112 years (total of 7013 wounds). These cases were deleted, leaving 338 902 wounds to be analyzed. There were a substantial number of wounds with zero initial depth, which were deleted (5600), leaving 333 302 wounds to be analyzed. There were 19 156 cases in which treatment time, defined in days as time of last visit minus time of first visit, was 0. These cases were deleted, leaving 314 146 wounds to be analyzed. There were also cases in which the age of the wound had a negative number; these were deleted (n=1314), leaving 312 832 wounds to be analyzed. Finally, there were 88 cases deleted in which the wound outcome was "no wound." A total of 57 190 cases were deleted, and 312 744 cases were analyzed.

Patient age was distinctly nonnormal, and the frequency distribution resembled a flattened pyramid. Therefore, age was categorized as follows: 19 through 39 years, 40 through 59 years, 60 through 79 years, and 80 years or older. Similarly, because the number of patient wounds (how many wounds a given patient had during the 4 years), wound initial area and depth, age of wound (before assessment at first visit), time to heal (for analyses other than Cox proportional hazards regression model), debridement frequency, and treatment time were also nonnormal (Kolmogorov-Smirnoff with Lilliefors correction, $P < .001$), even after log transformation, categories were created for each of the following parameters: number of patient wounds (1, 2, 3, 4, and ≥5), initial depth (≤0.25, 0.26-0.50, 0.51-1.0, 1.01-2.0, and >2.0 cm), initial area (<1, 1.01-5.0, 5.01-20.0, 20.01-100.0, and >100 cm^2), age of wound (<50, 51-99, 100-199, 200-999, and ≥1000 days), time to heal (<21, 21-42, 43-63, 64-98, and >98 days), interval between debride-

Figure 2. Healing Rates for the Different Categories of Wounds



ments (≤1, 1-2, and >2 weeks), and treatment time (22-42, 43-63, 64-83, and >84 days).

Healing outcomes were simplified to whether a wound healed. Healed was defined as a wound that had completely epithelialized with dimensions of 0 × 0 × 0 cm. Thirty-two wound type classifications were simplified to arterial ulcer, compromised skin graft/flap (ie, dusky flaps with vascular compromise), dehisced surgical wound, DFU, inflammatory ulcer, pressure ulcer, surgical wound, trauma, ulcer secondary to infection, VLU, and other. Physician specialty was simplified into 13 categories.

Statistical Analysis

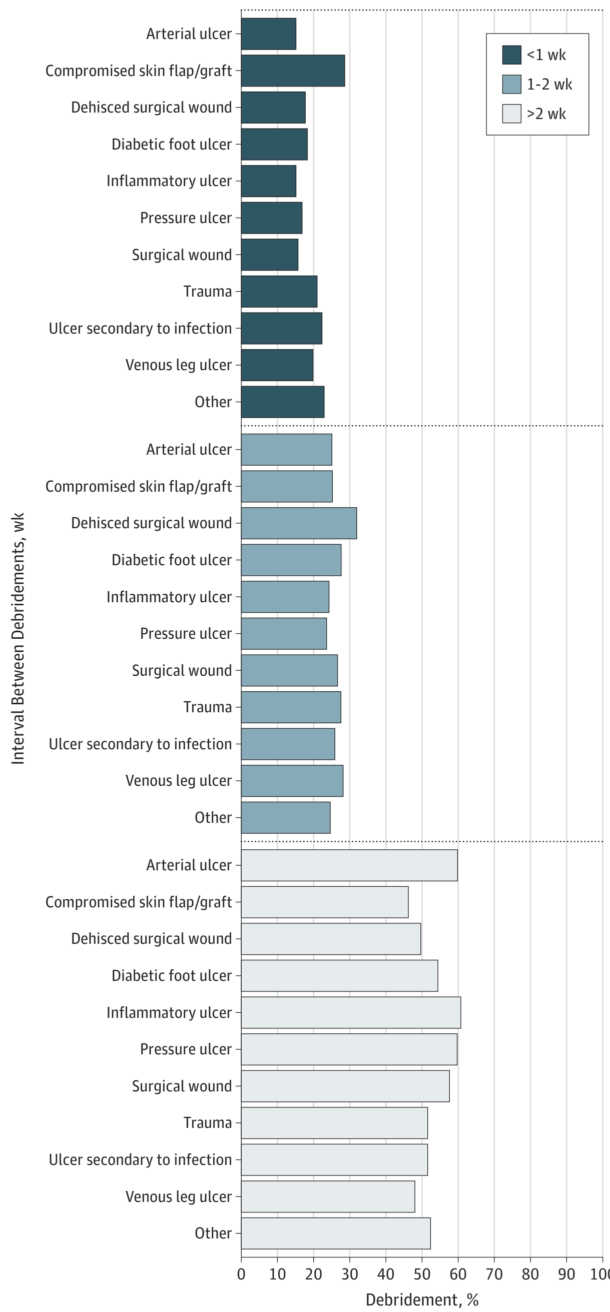
All statistical analyses were performed using SPSS PASW statistical software, version 19 (SPSS Inc). Cross-tabulations of patient and wound categorical factors were analyzed using the χ^2 test or γ/Kendall tau-b when levels were ordinal. Because data were nonnormal, variable descriptive data are reported for medians and ranges. Comparison of time to heal for wounds in regard to debridement frequency was conducted by Kaplan-Meier analysis and then Cox proportional hazards regression. The association between debridement frequency and patient and wound parameters was studied using ordinal logistic regression for DFUs in which debridement frequency was the dependent variable. In general, regression was conducted using the enter method in which all variables with a significance of $P < .10$ were initially retained and the models refined until only variables with a significance of $P < .05$ were left in the model. The proportional hazards assumption for the Cox proportional hazards regression model was checked using the Schoenfeld residuals proportional hazard test. The parallel lines of response (association between the independent variables and the logits) were analyzed graphically for the ordinal logistic regression.

Results

There were 154 664 patients in the study with 312 744 wounds. Of the patients, 47.1% were male, and the median age of the total population was 69 years (age range, 19-112 years). Most patients (59.2%) had a single wound when they first visited the clinic, whereas 16.4% had 2 wounds, 7.9% had 3 wounds, 4.7% had 4 wounds, and 11.7% had 5 wounds or more.

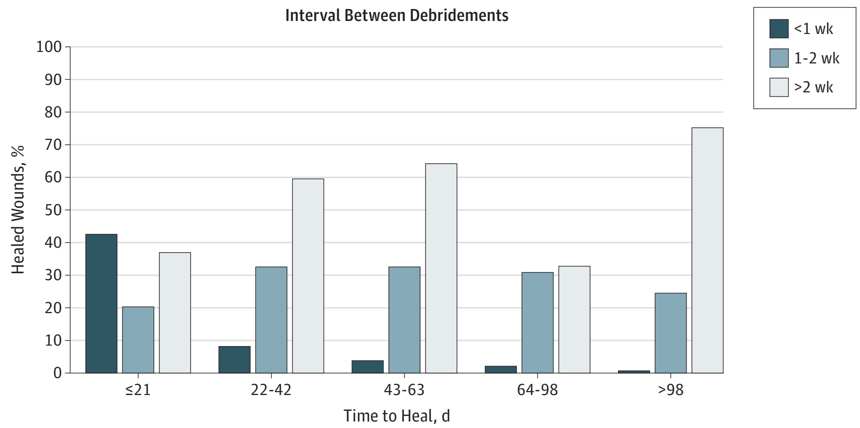
After simplification of wound causes, most wounds were DFUs (19.0%), VLUs (26.1%), and pressure ulcers (16.2%) (**Figure 1**). Characteristics of the different types of wounds varied considerably (**Table 1**). The largest wounds were compromised skin grafts/flaps, surgical wounds, and traumatic wounds

Figure 3. Percentage of Debridements by Interval Between Debridements According to Wound Category



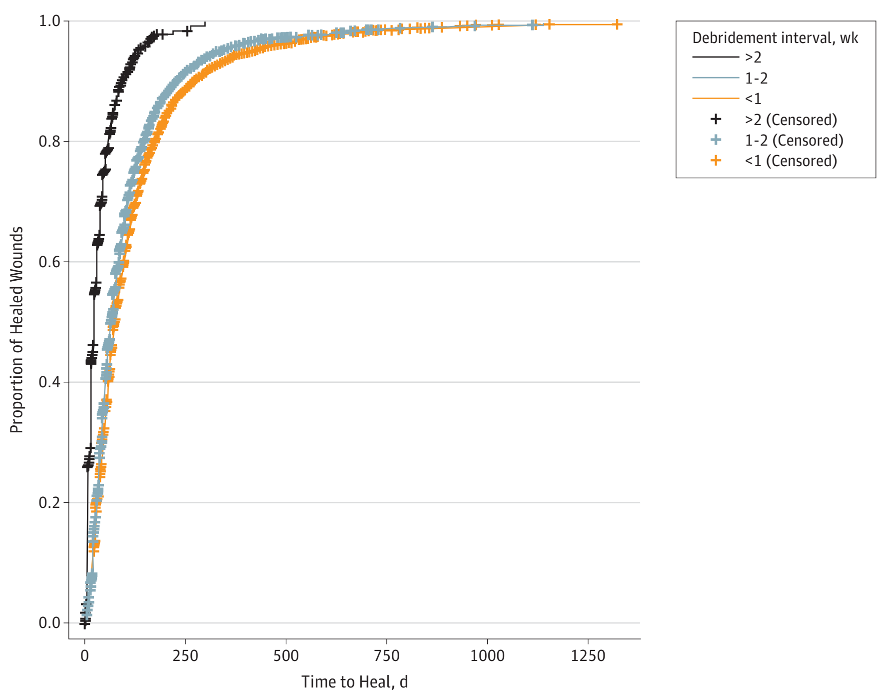
For each wound category, the sum of the different debridement frequencies is 100%.

Figure 4. Association Between Percentages of Healed Wounds and Time to Heal



Wounds with debridement intervals of 1 week or less healed significantly faster.

Figure 5. Kaplan-Meier Plot of Diabetic Foot Ulcers Showing That Shorter Intervals Between Debridement Improve Time to Heal



(median, 2.8, 2.88, and 2.85 cm^2, respectively). The deepest wounds belonged to surgical and dehisced surgical wounds (median, 0.5 cm). The oldest wounds were compromised skin flaps/grafts (median, 36 days) followed by arterial ulcers (median, 30 days).

Overall, 70.8% of wounds healed, with the highest rate for traumatic wounds (78.4%) and the lowest for pressure ulcers (56.6%) (**Figure 2**). The median number of debridements for all wounds was 2 (range, 1-138). Although there was a significant difference among wound types because the data set was very large ($P < .001$), in general, no remarkable differences were found in the proportions of wounds receiving different debridement frequencies except that compromised skin flaps/grafts had a higher proportion receiving weekly or higher-frequency debridement (**Figure 3**). However, in regard to time to heal, a significantly higher proportion of wounds that received weekly or more frequent debridement ($P < .001$) healed in a shorter time (**Figure 4**). Although this effect was present for all wound types, it differed slightly in magnitude according to wound cause. For example, the DFU median time to heal for weekly or higher-frequency debridement was 21 days compared with 64 and 76 days for 1- to 2-week or 2-week or more intervals between debridements, respectively (log-rank test, $P < .001$) (**Figure 5**). In contrast, for traumatic wounds, the median time to heal for weekly or higher-frequency debridement was 14 days compared with 42 and 49 days for 1- to 2-week

Table 2. Significant Variables in the Ordinal Logistic Regression Associated With Higher or Lower Debridement Frequencies

Variable[a]	β Coefficient[b]	OR (95% CI)	*P* Value
Sex, female	−0.059	1.06 (1.03-1.10)	<.001
Wagner grade			
3	0.118	0.89 (0.85-0.93)	<.001
2	0.115	0.89 (0.86-0.92)	<.001
Age of wound, d			
>1000	−0.007	1.01 (0.88-1.15)	.92
200-999	−0.136	1.15 (1.08-1.22)	<.001
100-199	−0.013	1.01 (0.96-1.07)	.67
51-99	−0.005	1.01 (0.96-1.05)	.84
Initial depth, cm			
>2.0	0.199	0.82 (0.71-0.96)	.01
1.01-2.0	0.279	0.76 (0.69-0.83)	<.001
0.51-1.0	0.298	0.74 (0.69-0.79)	<.001
0.26-0.5	0.329	0.72 (0.69-0.75)	<.001
Initial area, cm^2			
>100.0	−0.098	1.10 (0.92-1.32)	.27
20.01-100.0	−0.039	1.04 (0.97-1.12)	.28
5.01-20.0	0.060	0.94 (0.90-0.99)	.01
1.01-5.0	0.082	0.92 (0.89-0.96)	<.001
Treatment time, d			
>84	−2.670	14.44 (13.76-15.15)	<.001
64-83	−2.314	10.11 (9.53-10.73)	<.001
43-63	−2.171	8.76 (8.30-9.27)	<.001
22-42	−1.853	6.38 (6.07-6.70)	<.001
No. of patient wounds			
≥5	−0.190	1.21 (1.16-1.26)	<.001
4	−0.184	1.20 (1.13-1.28)	<.001
3	−0.154	1.17 (1.10-1.23)	<.001
2	−0.150	1.16 (1.22-1.25)	<.001
Wound outcome, not healed	0.493	0.611 (0.69-0.63)	<.001
Physician category			
Podiatry	−0.100	1.11 (1.06-1.15)	<.001
General surgery	−0.165	1.18 (1.13-1.23)	<.001
Family medicine	0.060	0.94 (0.90-0.99)	.02
Vascular surgery	−0.355	1.43 (1.33-1.53)	<.001

Abbreviation: OR, odds ratio.

[a] References for each variable are as follows: sex: male; Wagner grade: 1; age of wound: 50 days or less; initial depth: 0.25 cm or less; initial area: 1 cm^2 or less; treatment time: 21 days or less; patient wounds: 1; wound outcome: healed; and physician category: other specialty.

[b] Logistic coefficient.

or 2-week or more intervals between debridements, respectively (log rank test, $P < .001$) (plot not shown). The corollary of this pattern is that wounds with longer intervals between debridements showed no propensity to heal in shorter times.

To study these relationships, 2 different types of regression were performed: (1) an ordinal logistic regression, in which the dependent variable was frequency of debridement for DFUs, and (2) a Cox proportional hazards regression for all wounds. Because this was a study reporting preliminary results, we only focused on one of the major chronic wound causes in detail (DFUs); more regression analyses will be required to determine the effect for other types of wound cause.

The −2 log likelihood for the final ordinal logistic regression model was 74 744 (χ^2 = 16 720; $P < .001$) with nonsignificant Pearson and deviance parameters and a Nagelkerke R^2 of 0.289. However, there were issues with parallel lines of response in this model.

The odds ratios (ORs) for the significant variables varied considerably (**Table 2**). A higher OR (negative coefficient of the predictor variable) is associated with lower debridement frequency. A lower OR (positive coefficient) is associated with higher debridement numbers. Thus, when Wagner grade 1 is used as reference, higher Wagner grades have lower ORs (ORs = 0.891 and 0.889), signifying that they are associated with a higher number of debridements (as one might expect). There was a marginally lower OR for females receiving a slightly lower number of debridements, although the clinical interpretation of this finding is unclear. The response for initial depth revealed that deeper wounds tend to have higher numbers of debridements compared with very shallow wounds. For the initial area, there was also a dose-response relationship, albeit one in which smaller wounds have significantly higher numbers of debridements. Treatment time was the dominant variable, with a longer

Table 3. Significant Variables in the Cox Proportional Hazards Regression Model

Variable[a]	β Coefficient[b]	*P* Value	HR (95% CI)
Sex, male	0.028	<.001	1.03 (1.02-1.04)
Patient age, y			
40-59.9	−0.075	<.001	0.93 (0.91-0.95)
60-79.9	−0.057	<.001	0.95 (0.93-0.96)
≥80	−0.043	<.001	0.96 (0.94-0.98)
Wound type		<.001	
Arterial ulcer	−0.784	<.001	0.46 (0.44-0.47)
Compromised skin flap/graft	−0.496	<.001	0.61 (0.56-0.67)
Dehisced surgical wound	−0.201	<.001	0.82 (0.78-0.86)
Diabetic foot ulcer	−0.541	<.001	0.58 (0.57-0.59)
Inflammatory ulcer	−0.530	<.001	0.59 (0.57-0.61)
Pressure ulcer	−0.715	<.001	0.49 (0.48-0.50)
Surgical wound	−0.158	<.001	0.85 (0.84-0.87)
Traumatic wound	−0.080	<.001	0.92 (0.91-0.94)
Ulcer secondary to infection	−0.098	<.001	0.91 (0.88-0.93)
Venous leg ulcer	−0.363	<.001	0.70 (0.68-0.71)
Initial area, cm^2		<.001	
1.01-5.0	−0.261	<.001	0.77 (0.76-0.78)
5.01-20.0	−0.473	<.001	0.62 (0.62-0.63)
20.01-100.0	−0.622	<.001	0.54 (0.53-0.55)
>100	−0.658	<.001	0.52 (0.50-0.54)
Initial depth, cm		<.001	
0.25-0.5	−0.385	<.001	0.68 (0.67-0.69)
0.51-1.0	−0.414	<.001	0.66 (0.65-0.67)
1.01-2.0	−0.471	<.001	0.62 (0.61-0.64)
>2.0	−0.618	<.001	0.54 (0.52-0.55)
Age of wound, d		<.001	
51-99	−0.201	<.001	0.82 (0.81-0.83)
100-199	−0.337	<.001	0.71 (0.70-0.73)
200-999	−0.510	<.001	0.60 (0.59-0.61)
≥1000	−0.757	<.001	0.47 (0.45-0.49)
Physician category		<.001	
Cardiothoracic surgery	−0.168	<.001	0.85 (0.80-0.89)
Emergency medicine	0.072		1.08 (1.04-1.11)
Family medicine	0.024	.10	1.03 (1.00-1.06)
General surgery	−0.047	.001	0.95 (0.93-0.98)
Infectious diseases	−0.072	<.001	0.93 (0.90-0.97)
Internal medicine	−0.010	.53	0.99 (0.96-1.02)
Orthopedic surgery	−0.068	.009	0.94 (0.89-0.98)
Physical medicine and rehabilitation	−0.015	.50	0.99 (0.94-1.03)
Plastic surgery	−0.130	<.001	0.88 (0.85-0.91)
Podiatry	−0.093	<.001	0.91 (0.89-0.94)
Unknown	0.059	<.001	1.06 (1.03-1.09)
Vascular surgery	−0.109	<.001	0.90 (0.87-0.93)
Debridement frequency		<.001	
1-2 wk	0.196	<.001	1.22 (1.21-1.23)
Weekly or more frequent	1.448	<.001	4.26 (4.20-4.31)

Abbreviation: HR, hazard ratio.

[a] References for each variable are as follows: sex: female; patient age: 19 to 39.9 years; wound type: other; initial area: 1 cm^2 or less; initial depth: 0.25 cm or less; age of wound: 50 days or less; physician category: other specialty; and debridement frequency: less than every 2 weeks.

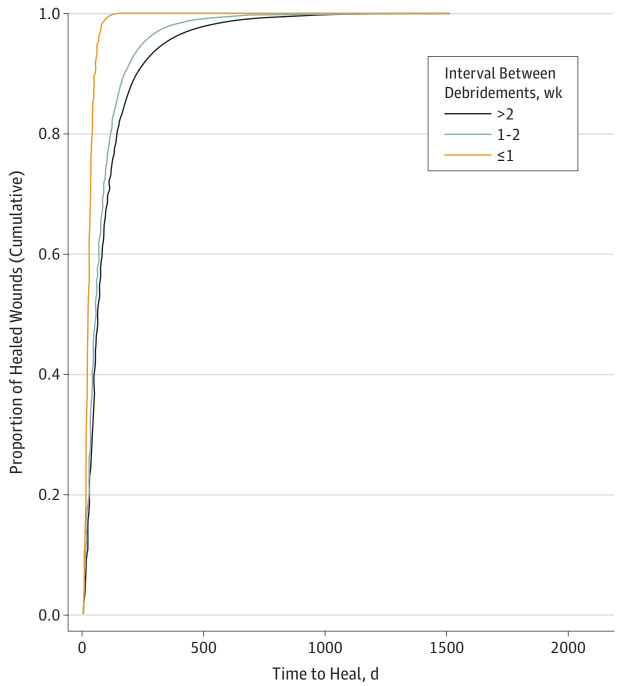
[b] Logistic coefficient.

treatment time associated with lower debridement numbers. The number of past and/or concurrent wounds a patient had when first seen with a new wound at a clinic was a significant variable, but compared with having no past or concurrent wounds, the association was fairly similar. Thus, one could conclude that fewer debridements are performed for subsequent wounds. In regard to age of the wound, only wounds 200 to 999 days old had a slightly lower debridement frequency compared with the youngest of wounds. Nonhealed wounds were associated with significantly higher numbers of debridements. Finally, with regard to physician specialty, compared with all other types of specialty (the reference), vascular surgeons tended to debride less compared with podiatrists or family medicine physicians.

The −2 log likelihood for the Cox proportional hazards regression model was 4 882 776 (χ^2 = 93 458; P < .001). No substantial deviations in regard to proportionality of hazards were observed based on partial residual plots using scaled Schoenfeld residuals.

There were 8 significant variables (**Table 3**). Male sex marginally but significantly decreased time to heal based on the hazard ratio (HR; HR = 1.03). However, increased area, depth, and age of wound and age of patient all significantly elevated the HR in a dose-dependent manner, which means that time to heal lengthened as these parameters increased in value. For example, compared with small-area wounds (≤1 cm^2), the HR for the largest-area wounds (>100 cm^2) was 0.52, whereas for the deepest wounds (>2.0 cm) the HR was 0.54, with shallow wounds (<0.25 cm) as a reference (Table 3). With other wound types as a reference, all other types of wounds had a significantly lower HR, although arterial ulcers and pressure ulcers had the lowest HRs (HRs = 0.46 and 0.49, respectively). Traumatic wounds and ulcers secondary to infection had relatively the highest HRs (HRs = 0.92 and 0.91, respectively). When other specialties were used as the reference, most physician categories had lower HRs (range, 0.85-0.99), but emergency medicine, family medicine, and unknown specialties had marginally higher but significant HRs (range, 1.03-1.08). Most importantly, after adjusting for all other significant factors, higher debridement frequencies resulted in increased HRs with regard to healing when compared with an interval between debridements of less than 2 weeks. In particular, higher weekly debridement rates resulted in an HR of 4.26 (95% CI, 4.20-4.31). **Figure 6** shows this outcome in relation to time to heal.

Figure 6. Kaplan-Meier Plot After Adjustment for All Confounding Variables Showing That Shorter Intervals Between Debridement Improve Time to Heal



Discussion

More than 312 000 wounds of all types were analyzed in nearly 155 000 patients, making this study the largest, most comprehensive work to date on debridement and healing outcomes. The results demonstrate that a higher frequency of debridement improves healing outcomes with shorter healing rates (Figure 4). Longer treatment time was associated with less debridement. Furthermore, wounds with longer intervals (>2 weeks) between debridements healed more slowly (Figure 6).

Previous work on debridement has been mainly retrospective.[12] However, unlike the current study, sample sizes have been significantly smaller and have focused primarily on burns, DFUs, and/or VLUs. Furthermore, most work has only tested whether to debride, and little work has examined the frequency of debridement.

As previously mentioned, the PDGF study on DFUs conducted by Steed and colleagues[7] provided the most significant evidence that frequent, weekly debridement improves healing. Ten centers treated 118 DFUs. Each ulcer received debridement before the trial began to remove all callus, dead, and granulation tissue followed by debridement at weekly follow-up visits in both the PDGF-treated group and control group. Centers that performed less frequent debridement had less successful healing outcomes in both groups. In the PDGF-treated group, 48% of ulcers healed compared with 25% in the control group.[7] However, the potentially confounding PDGF therapy was not assessed in regard to healing outcomes and debridement patterns.

The other main retrospective study[10] that tested a correlation between debridement frequency and healing outcomes only examined VLUs and DFUs. Data from 2 controlled, prospective, randomized pivotal trials of topical treatments on 366 VLUs and 310 DFUs during 12 weeks were analyzed.[10,13] In the VLU study, 25 centers participated, each with multiple patients enrolled. In centers in which frequent debridement was performed, the median healing rate was 50% compared with 28% in centers with less frequent debridement. The VLUs that underwent surgical debridement had a significantly higher median wound surface area reduction compared with VLUs that were not debrided (34%, P = .02). In the DFU study, 35 centers participated, 30 of which had multiple patients. The healing rate was 30% in centers with frequent debridement vs 13% in centers with less frequent debridement. In summary, higher rates of healing in both ulcer types were observed in centers that debrided more frequently (P = .007 for VLUs, P = .02 for DFUs). Other significant variables that affected wound closure were the initial wound size, the duration of infection, and, for VLUS only, the duration of the wound.[14]

Interestingly, debridement frequency and healing rates were not correlated for all patients. The authors suggested that frequent debridement by center may be associated with increased healing because of their use of aggressive surgical debridement therapy for all wounds, including healthy, chronic, and infected. They concluded that frequent debridement of DFUs and VLUs may improve healing outcomes, but there was only minor evidence to support a significant effect, noting that the study protocols were not designed to evaluate debridement.[14]

Indeed, many studies were not specifically designed to evaluate debridement but rather a specific advanced product or treatment that might have worked synergistically with debridement to improve outcomes; for example, in a randomized controlled study,[15] investigators found higher healing rates when a pneumatic pump for foot compression was used after sharp debridement.

Strengths of the current study include its sample size, inclusion of all wound causes, and the decision to exclude advanced therapeutic treatment. The main limitation of this study is the use of retrospective data. In regard to the statistical analysis, issues with the parallel lines of response in the final ordinal logistic regression model were a limit of the model. Finally, for individual causes, further analysis will be necessary to determine the precise effect size due to debridement frequency because certain causes will have unique factors that may come into play.

Analysis of the largest wound data set evaluated to date in this retrospective study suggests that the more frequent the debridement, the better the healing outcome. The issue remains that there has not yet been an adequately powered prospective trial to test the efficacy of debridement on wounds.

ARTICLE INFORMATION

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Study concept and design: Wilcox, Covington.
Acquisition of data: Wilcox.
Analysis and interpretation of data: All authors.
Drafting of the manuscript: Carter.
Critical revision of the manuscript for important intellectual content: All authors.
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