CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 439, pp. 79–86

Evaluation of Diabetic Wound Classifications and a New Wound Score

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We review seven classification systems for foot wounds in patients with diabetes and evaluate them in a table format based on 10 criteria judged to be the most important for assessing their effectiveness. Criteria include such factors as objectivity, versatility, ability to measure progress, validity and reliability, and five other grading parameters. Concomitantly, the Wound Score, a paradigm for evaluating the problem wound, is described in detail and evaluated on the same ten criteria. Five assessments including appearance of the wound base, size, depth, bio-burden, and perfusion are each graded on a 0 to 2 scale and summated to generate the Wound Score. From the score three levels of seriousness become apparent: "healthy wounds" with scores of 8 to 10, "problem wounds" with scores of 4 to 7 and "futile wounds" with scores of 0 to 3. Because of its simplicity, user friendliness, ability to integrate wound and patient information, and design to reflect progress, the Wound Score scored better on the 10 evaluation criteria than any other foot wound evaluation system for patients with diabetes. The objectivity of grading the five assessments used to generate the Wound Score make this scoring system ideal for evaluating treatment interventions and outcomes of wounds of equal seriousness.

Evaluation is the first step in treating a wound. Many approaches are used to evaluate wounds. Probably the most frequently used approach, especially by those experienced in treating wounds, is direct observation. As important as experience is, this leads to lack of objectivity and disregard for evidenced-based indications by the treating physician. Furthermore, when a physician reviews treatment outcomes, there is the temptation to disregard results for patients in whom treatments have failed, by using excuses that the patient's problem was an outlier, treatment instructions were not followed, the patient was noncompliant, or combinations of these. Consequently, comparison of outcomes from wounds of equivalent severity may lack objectivity especially if evaluations are based on direct observation only and subject to bias of the treating physician.

Wound scoring systems have been developed to mitigate these deficiencies. These scoring systems are separated into two types: those designed to evaluate foot wounds in patients with diabetes and those for pressure sores. Although there are over a dozen different wound scoring systems for diabetic foot wounds as well as pressure sores, none is optimal for the strategic treatment of problem wounds.[4–9,18,20] Few if any of them integrate well with other aspects of treatment such as the patients' healing responses, prevention of recurrences, patient motivation, and diagnostic studies. In general, neither foot wound nor pressure sore scores, is suited for evaluating a wound at a location other than that for which it was specifically designed such as the foot for the diabetic wound scores. In addition, the generally accepted risk factors for lower limb amputations in patients with diabetes generally are not considered. These risk factors include: (1) deformity, (2) peripheral vascular disease, (3) history of previous foot wound, (4) a previous amputation involving some portion of the lower limb, and (5) neuropathy. Other risk factors in patients with diabetes who have wounds include obesity, end-stage renal disease, malnutrition, collagen vascular diseases, use of immunosuppressants, age, and use of inappropriate footwear.

A number of questions arise when classifications of wounds in patients with diabetes or pressure sores are studied. First, is the classification appropriate for the site of the wound? Second, what is the basis for selecting the classification used; popularity or validated and reliable information? Third, is the classification system user

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DOI: 10.1097/01.blo.0000182393.31978.c3

friendly based on easy to derive conclusions from objective assessments? Fourth, does the classification system focus on the essential elements needed to determine the seriousness of the wound and provide a justification for treatment? Finally, can the classification system document progress and be used to compare outcomes?

With the above considerations, we initiated this review with two primary objectives: (1) to appraise critically seven previously published articles on wound scoring systems for foot wounds in patients with diabetes and (2) to report our experiences with a wound score devised by the first author (MBS) that addresses the deficiencies that exist in the foot wound and pressure sore classification systems for patients with diabetes. Secondary objectives include the demonstration of how the wound score aids in the management and prevention of wounds and the advantage it offers for selecting wounds of similar seriousness for comparison of the effectiveness of interventions.

Appraisal of Foot Wound Scoring Systems for Patients with Diabetes

It is obvious that some parameters for evaluating wounds in general and foot wounds in patients with diabetes in particular are more important than others. In the seven foot wound scoring systems for patients with diabetes that we evaluated for this review, more than 30 different findings and secondary elements are considered for grading the wound (Table 1). The following are brief descriptions of the seven classifications of foot wounds for patients with diabetes that we evaluated.

Wagner, 1979 (Los Angeles, CA)

In this system, wounds are graded from 0 to 5 using various evaluation criteria such as depth, location, and necrosis.[20] Only one criterion is used for establishing the score for any particular wound. Detailed algorithms based on Doppler ankle-brachial indices are used as guidelines for treatment, with about 50 permutations. The widespread use of this system makes it the system with which all subsequent scoring systems are compared, but to our knowledge, no validity or reliability studies evaluating this system have been done. Outcomes were based almost entirely on the healing of lower limb amputations done at various levels.

Forrest and Gamborg-Neilsen, 1984 (Boden, Sweden)

This system was designed to provide guidelines for medical versus surgical treatment of wound problems in the feet of patients with diabetes.[4] Wound problems are divided into six types based largely on wound contamination. Nine subjective and nine objective variables are used for wound assessment. An algorithm provides guidance for when to

TABLE 1. Findings and Criteria Used to Evaluate Wounds

Findings	Secondary Considerations
1. Depth	a. Cavitation
	b. Length of tract
2. Size	a. Undermining
	b. Recess
	c. Tunneling, bridging
3. Infection	a. Colonization
	b. Cellulitis
	c. Sepsis
4. Tissue viability	a. Healthy
	b. Compromised
	c. Marginally viable
	d. Nonviable, necrotic
5. Perfusion	a. Adequate; ABI > 0.5
	b. Inadequate; ABI < 0.5
6. Wound base	a. Appearance
	b. Characteristics
	c. Drainage
	d. Odor
7. Adjacent skin	a. Edema
	b. Color
	d. Induration
	e. Maceration
	f. Ecchymoses
	g. Lichenification
8. Anatomy	a. Location
	b. Deformity
	c. Biomechanics
9. Neuropathy	a. Sensory
	b. Motor
	c. Autonomic
10. Shape	a. Smooth, geometric (eg, round, ovoid)
	b. Irregular
11. Appearance of wound edges	a. Sharply demarcated
	b. Serpiginous
	c. Heaped up
	d. Epithelialization at margins
12. Contraction	a. None, nonphysiological
	b. Physiological
13. Phases of healing	a. Latency
	b. Granulation tissue formation
	c. Epithelialization and coverage
14. Tissue involvement	a. Superficial: skin and subcutaneous tissues
	b. Intermediate; muscle and tendon
	c. Deep; bone and joint
15. Quality of skin	a. Skin atrophy
	b. Hidebound, adhesions
	c. Hyperpigmented, bronzed
	d. Hyperkeratoses, calluses
	e. Attenuation over bony prominences
16. Compliance	a. Motivation
	b. Consistency in following advice
	c. Family support
17. Nutrition	a. Normal albumin and pre-albumin
	b. Borderline values
	c. Severely depressed values

ABI = Ankle-brachial index

use surgical debridements, wound dressing agents, saline dressings, and surgical procedures.

Knighton et al, 1986 (Minneapolis, MN)

Fourteen different wound descriptors arbitrarily are assigned different values to give wound scores from 0 to 97.[6] Scoring is time consuming and cannot be done without a printed worksheet. Of all the scoring systems, this one is the most comprehensive. It was designed to justify outcomes for wound centers using platelet-derived wound healing factors under the stewardship of the first author.

Pecoraro and Reiber, 1990 (Seattle, WA)

This classification was designed to "encompass the spectrum" of findings in the treatment of the feet of patients with diabetes, from intact skin to deep wounds with extensive necrosis.[9] Wounds are divided into one of 10 classes based on structural (morphologic and anatomic) criteria obtained from clinical observations of the wound base. The classes are compared with similar findings in the Wagner,[20] Forrest and Gamborg-Nilsen,[4] and Knighton et al[6] scoring systems. Infection is listed as being present, absent, or not applicable. Wound locations are coded into 39 sites for the two feet.

Lavery et al, 1996 (San Antonio, TX)

Wounds are classified into one of 16 types using a 16-square matrix.[7] The horizontal scale is based on wound depth, whereas the vertical scale is based on infection, ischemia, or combinations of the two. This scoring system was designed to predict outcomes better than the previously available scores. Validating data are provided in a subsequent report.[2]

MacFarlane and Jeffcote, 1999 (Nottingham, UK)

Five criteria each are graded from 0 to 4 generate a wound score from a 24 square matrix.[8] This results in more than 1000 possible permutations (5 assessments each graded to 0–4) for grading wounds. The criteria include area, depth, sepsis, arteriopathy, and denervation. Objective criteria ranked by severity are used for making determinations. The system is dynamic; as the wound improves, the score changes. Authors of a validity study showed significant differences in outcomes based on the all the criteria except neuropathy.[19]

Foster and Edmonds, 2000 (London, UK)

Six stages are used to describe the "natural history of the diabetic foot [sic] on the road to amputation."[5] One or more of five risk factors supplement other findings such as ulceration, infection, ischemia, and necrosis in determining the stage. The authors provide recommendations for managing each stage that include mechanical control, microbiological control, metabolic control, vascular control, wound control, and educational control.

Appraisal of the Seven Wound Classification Systems

We evaluated each of the seven foot wound evaluation systems for patients with diabetes using 10 assessments (Table 2). Each assessment was graded on a three-point scale: 2 points indicated that there was good supporting data and/or the ability to measure the assessment was good; 1 point indicated that there was some supporting information and/or the ability to measure the assessment was fair; and 0 points indicated that there was no supporting information and/or the ability to measure the assessment was poor or nonexistent (Fig 1).

The Wound Score—A Paradigm for Wound Evaluation

From the above information, several conclusions become apparent. First, no foot wound evaluation system for patients with diabetes is ideal. Several authors address this by stating their system was designed to correct specific

TABLE 2. Assessments Used for Evaluating Seven Wound Scoring Systems

Parameter	Miscellaneous
1. Number of criteria for evaluation	
2. Objectivity of findings to evaluate each criterion	
3. Scoring permutations	Number of criteria times information used to evaluate each criterion
4. Versatility	Useful for locations other than the foot
5. Guide to seriousness	Potential for wounds to heal
6. Integration with wound information	Uses additional information about the wound
7. Integration with patient information	Uses information about the host-function factors, nutrition, and patient motivation, etc
8. Documentation of progress	Wound scores change as wounds improve (or deteriorate if that be the case)
9. Validity	Accuracy measuring wound characteristics; Predictor of outcomes
10. Reliability	Reproducibility of measurements

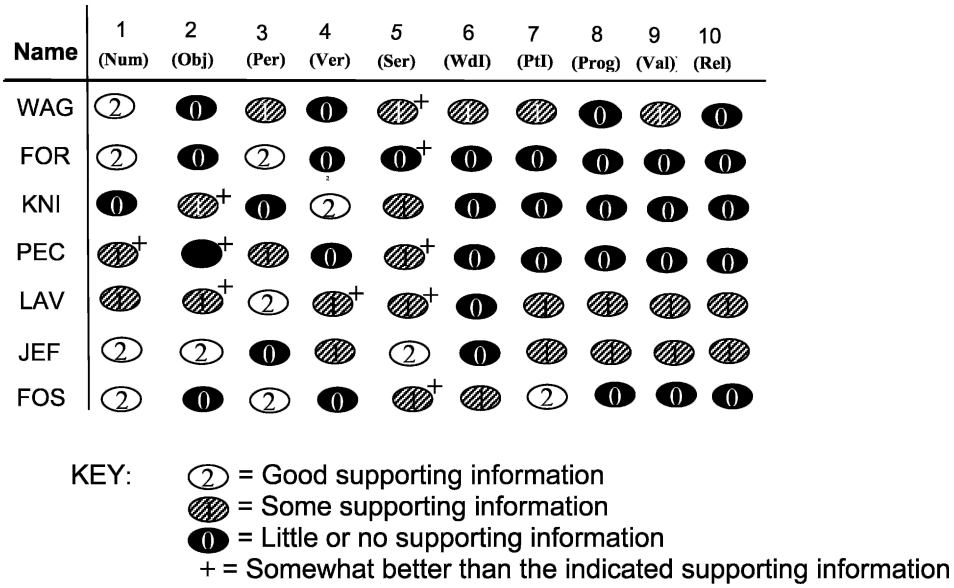

Fig 1. The evaluation of seven wound scoring systems using 10 criteria for treating foot wounds in patients with diabetes is shown. FOR = Forrest and Gamborg-Neilsen; FOS = Foster and Edmonds; KNI = Knighton et al; LAV = Lavery et al; JEF = Jeffcote and MacFarlane; PEC = Pecoraro and Reiber; WAG = Wagner; 1. Num = Number of assessments for evaluation; 2. Obj = Objectivity of findings to evaluate each criterion; 3. Per = Scoring permutations; 4. Ver = Versatility; 5. Ser = Guide to seriousness; 6. WdI = Integration with wound information; 7. PtI = Integration with patient information; 8. Mea = Measurement of progress; 9. Val = Validity; 10. Rel = Reliability

deficiencies present in previously published systems.[5,8,9] Second, even though more than 30 findings are used among the seven systems to generate wound scores, they obviously cannot all be of equal importance in assessing the seriousness of the wound and making treatment decisions (Table 1). That is, some findings are more important than others. Third, many of the scoring systems are designed specifically for wounds of the foot and are not applicable for classifying diabetic and/or pressure sore wounds in other parts of the body.[5,8,9,20] Fourth, few of the authors generated their systems so that scores are intuitively obvious as to the seriousness of the wound.[6,8,9] Some scores are based from best to worst findings and others are based on number scales, some with high numbers being best and others with low numbers being best.[6,8,9] Fifth, even though several authors provide guidelines describing specific interventions that should be done for each grade or score in their systems, none integrate other important factors associated with wound healing in an algorithmic fashion such as patient status, nutrition, and patient motivation.[4–9,18] Finally, only a couple of the scoring systems were designed to be dynamic; that is, as the wound improves, wound scores or grades improve.[6,8]

The first author (MBS) generated a wound score to mitigate the criticisms of the other scoring systems.[13,14,16,17] The wound score uses five assessments judged to be the most important for evaluating wounds and contributing to treatment decisions (Fig 1). Each assessment is graded using highly objective parameters on a 0 (worst possible situation) to 2 (best possible situation) scale using whole numbers. However, half points may be used when observations are intermediate or mixed between two findings. When the scores of the five are summated a wound score from 0 to 10 is generated. It is intuitively obvious that a score of 10 is ideal and a score of 0 the worst possible situation. In this respect, the Wound Score compares to the Apgar Score, a quick, speedy, dynamic, highly objective, 10-point system universally accepted for evaluation of the newborn baby one and five minutes after birth.[1]

The wound score quantitatively defines three wound types that integrate with a master wound algorithm (Fig 2). For wounds scores in the 7-point to 10-point range (termed healthy wounds), almost any treatment that does not dam-

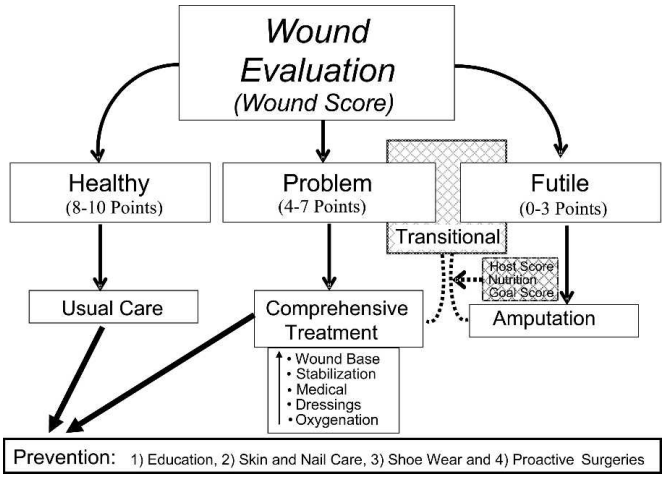

Fig 2. The algorithm for evaluation, treatment, and prevention of wounds, based on the wound score, is shown.

age the healing tissues will have a successful outcome. For wounds scored in the 4-point to 7-point range (termed problem wounds), a multidisciplinary approach with attention to (1) surgical treatment of the wound base, (2) optimization of medical care, (3) wound stabilization and protection, (4) selection of the appropriate wound dressing agents, and (5) wound oxygenation by those most expert in delivering each element is recommended to achieve the best possible results. Successful outcomes are expected in 80% of patients who are treated with this approach.[15]

For wounds scores in the 0 to 3 points range (termed futile wounds), treatment for lower extremity wounds in almost all cases is lower-limb amputation. If futile wounds consist of pressure sores in the pre-sacral, ischial, and/or hip regions, then "compassionate care" is recommended. Compassionate care consists of (1) comfort measures, (2) interventions to facilitate care such as percutaneous and limited open releases of severe hip and knee flexion contractures and (3) measures to preserve the dignity of the patient. Occasionally, futile wounds in the lower limb can be successfully revascularized. Once this occurs, the wound score would likely improve out of the futile range, verifying its dynamic characteristics and ability to predict healing when strategic management is initiated.

In wounds with scores in the futile-problem wound transitional range, information from the patient's health status and function (Host Score), nutrition status, and patient motivation (Goal Score) must be considered as included in the master algorithm, in making a decision to save or amputate the extremity (Fig 2). Another way to describe wounds of this type is by using the descriptive term of "end-stage" wound. End-stage implies that lower limb amputation or comfort care measures (for the situation of pressure sores) have been recommended by experts in wound care for the treatment of the wound. The host and goal scores are both ten point systems using five assessments, like the wound score, that are used to make a decision whether or not it is feasible to attempt to salvage the end-stage wound.[14]

Assessments for Determining the Wound Score

The five assessments used for determining the wound score include (1) appearance of the wound base, (2) wound size, (3) wound depth, (4) bio-burden, and (5) perfusion (Table 3). The appearance of the wound base easily is determined by visual examination. A red base is scored two points, a white (fibrinous membrane) or yellow (exudative) base is scored one point, and a black base is scored zero points.

Rather than using absolute measurements, relative measures easily obtained by direct observation are used to evaluate wound size. If the wound surface area is less than the patient's thumbprint area, it is graded 2 points; if the size is between thumbprint and fist size, it is graded 1 point; and if it is larger than fist size, it is graded 0 points. If undermining or recesses are present, the wound size is based on the extent of this rather than on the surface area of the opening.

Wound depth is also determined by direct observation. Two points are assigned if the wound base consists of skin or subcutaneous tissue, 1 point if muscles and/or tendons are seen, and 0 points if the bone and/or joint is exposed. If the wound opening is small with a tract to deeper tissues, the tissue at the end point of the tract is used to establish the depth assessment.

The seriousness of the wound infection is the criterion used to establish the bio-burden assessment. Colonized wounds without a substantial bio-burden are given a two-point grade. If the margins are cellulitic and/or macerated, 1 point is assigned. If the infection burden leads to systemic sepsis, the grade for this assessment is 0. Information that confirms the presence of sepsis includes unstable blood sugars, leukocytosis, positive blood cultures, fevers and chills, or malaise.

TABLE 3. The Wound Score

Criteria	2 Points* (Best)	1 Point* (Fair-to-Good)	0-Points* (Worst)
Appearance (Wound base)	Red	White, Yellow (or thin nonfluctuant eschar)	Black (necrotic, wet gangrene, or fluctuant eschar)
Size (Include undermining, recesses and tunneling)	Less than the surface area of the patient's thumb print	Thumbprint sized to fist sized	Larger than fist sized
Depth (Include maximum depth of probing)	Skin or subcutaneous tissue	Muscle and/or tendon	Bone and/or joint
Bio-burden	Colonized	Cellulitic and/or macerated margins	Septic (unstable blood sugars, leucocytosis, positive blood cultures etc)
Perfusion	Palpable pulses	Doppler pulses (triphasic or diphasic)	Monophasic or no pulses

*Note: Use half points if findings are mixed or between two scores

Perfusion is the most challenging of the five wound score assessments to grade objectively. This is because edema, cicatrix, wounds, crusts, verrucous changes of the skin, hyper-pigmentation with underlying fibrosis, wounds in areas in which pulses are not available (for example, pre-sacral and trochanteric pressure sores), or combinations of these may interfere with the direct assessment of perfusion. Two points are given for this assessment if one or more pulses are palpable. If triphasic or biphasic pulse waves are detected with a Doppler probe, one point is awarded. If Doppler pulses are absent or monophasic, zero points are assigned. Secondary methods may be used to determine the perfusion grade when direct assessment is obscured by the conditions described above or if a Doppler monitor is not available.[10] These include warm skin temperature and normal capillary refill (2 points), cool skin temperature and sluggish capillary refill (1 point) or cold skin temperature, cyanotic or pale skin color, or absent capillary refill (0 points).

A Critical Evaluation of the Wound Score

The Wound Score is designed to resolve the deficiencies, concerns, and lack of objectivity of the diabetic foot wound scoring systems (or scoring systems for serious wounds at other body sites) currently available. If the same criteria that were used previously to evaluate the foot wound classification systems for patients with diabetes are applied to the Wound Score, an objective assessment of this paradigm for wound scoring becomes possible. From this critical evaluation, the value and usefulness of the Wound Score becomes obvious.

Number of Assessments Used to Determine the Wound Score = 2 Points (Ideal)

Five assessments are measured. This is considered to be a very manageable number among the lowest of any of the other diabetic foot wound scoring systems. Furthermore, the assessments are easy to remember by using the pneumonic ASDIP [A = appearance, S = size, D = depth, I = Infection (bio-burden), and P = perfusion].

Objectiveness of Findings to Grade Each Assessment = 2 Points (Ideal)

As presented earlier, the grading of each assessment is objective, for example in the case of the wound base appearance as easy as differentiating the colors red, white/yellow or black. The establishment of objective criteria for scoring was one of the main goals in generating the Wound Score. Secondary and tertiary goals with respect to objectiveness were user friendliness and expediency. Each finding is so objective that reliable grading can be done by even an inexperienced observer and done without instruments or measuring devices in a few moments.

Scoring Permutations = 1.5 Points (Fair-to-Ideal)

With five assessments, each with three possible grades, a total of 15 permutations are possible. However, by using zero for one of the grades, like the Apgar score, wound scores range from 1 to 10. These numbers are not unwieldy. Furthermore, by lumping the scores into three levels of seriousness (healthy = 7–10 points, problem = 4–7 points, and futile = 0–3 points, only three choices arise as to what management is indicated (Fig 2).

Versatility (for Types of Wounds and Location of Wounds = 2 Points (Ideal)

The Wound Score has versatility that is not offered by any of the other scoring systems we have evaluated. That is, it is not limited to use in foot wounds, but can be used equally well for wounds throughout the body including pressure sores, necrotizing soft tissue infections, refractory osteomyelitis, trauma, venous stasis ulcers, and those wounds associated with collagen vascular diseases.

Indication of Seriousness Using a Scoring Range That Is Familiar and Logical = 2 Points (Ideal)

By using a 0-point to 10-point scale, seriousness is appreciated intuitively. It is common usage to consider a score of 10 as perfect and score of 0 as the worst possible situation. The 0 to 10 score range lends itself to establishing, numerically, three wound types (healthy, problem, and futile) to define seriousness.

Ability to Integrate with Other Wound-Related Information = 1.5 (Fair-to-Ideal)

Although the wound score was generated to provide a comprehensive evaluation by itself, it integrates fairly well with other wound-related information. For example, laboratory studies help in the assessment of the bio-burden. Imaging studies may help to verify the size and depth of the wound and to confirm the presence of deformities. Juxta-wound transcutaneous oxygen measurements integrate well with the perfusion assessment.

If juxta-wound oxygen tensions are normal (> 40 mmHg), this equates to a perfusion assessment of 2. If the transcutaneous oxygen measurements are < 40, but increase to more than 200 during a hyperbaric oxygen exposure, the perfusion grade is 1. Juxta-wound transcutaneous oxygen tension less than 50 mmHg while going through hyperbaric oxygen are assigned 0 points whereas tensions in the 50 to 200 range are given a score of ½ point. Other wound related information such as peri-wound edema, characteristics of the wound margins, shape of the wound, location of the wound, and appearance of the adjacent skin are useful for further describing the

wound, as in a chart note but are not considered essential for wound scoring.

Ability to Integrate with Patient-Related Information = 1.5 Points (Fair-to-Ideal)

The wound score was designed with the secondary goal of integrating with other patient-related information (Fig 2) such as (1) The Host Score (which includes grading of age, ambulation, cardiovascular/renal status, smoking, steroid use, and neuropathy; (2) Nutrition Status; and (3) The Goal Score (based on patient comprehension, motivation, compliance, family support and ability to do activities of daily living). When wounds are "end-stage" and wound scores are in the transitional zone between problem and futile, information from the Host Score, Nutrition Status, and Goal Score is very useful in making rational decisions whether to attempt limb salvage or to proceed directly to a limb amputation.

Measurement of Progress (As the Wound Improves or Worsens, Scores Change) = 2 Points (Ideal)

Documentation of progress is a very desirable feature of the Wound Score and is one not found in many of the other foot wound evaluation systems for patients with diabetes. Improvement in wound healing is reflected by increasing wound scores. This provides an objective measurement of progress. It also helps with the treatment. For example, as the Wound Score improves from problem (4–7 points) to healthy (8–10 points), interventions can be reduced from labor-intensive dressing changes to agents that the patient or patient's family can manage with daily dressing changes. Conversely, if the wound scores do not improve, reassessment and change of treatment are required. Consultations from vascular surgery, clinical nutrition, infectious disease, nephrology and hyperbaric medicine may be required. Additional studies such as an Indium scan (to assess for osteomyelitis), angiography, and transcutaneous oxygen measurements in room air and with hyperbaric oxygen may be needed to determine why the wound is not improving and what additional interventions are needed.

Validity (How Well Scores Predict Outcomes) = 1.5 Points (Fair-to-Ideal)

Validity studies were done on more than 100 of our patients, about half done retrospectively and the other half done prospectively.[12] When the initial wound score was in the problem (4–7 points) or healthy (7–10) range, accuracy for predicting good outcomes (healed or healing wounds) approached 90%. Before it is appropriate to state that the validity of the Wound Score is "ideal," studies at institutions other than the first authors (MBS) need to be reported.

Reliability (Similarity of Scores from Different Observers) = 1 Point (Fair)

Because of the objectivity of the findings used to score each assessment and the ease with which the scores can be obtained, the reliability of the wound score is expected to be high. In some early unreported observations (2000) of the first author (MBS), the kappa value (for reliability) approached 0.9 when wound scores were obtained by an orderly, a hyperbaric nurse wound specialist and the first author. When attendees at a conference during this time were invited to grade a variety of wounds from photographs (and some supportive information such as hemograms and perfusions assessments), the kappa values were in the 75% range. Because of the objective nature of the wound score it is that high kappa values will be reported in studies specifically designed to assess its reliability. The perfusion assessment requires the most skill to obtain.

DISCUSSION

The wound score is a paradigm for wound evaluation and management. Although it represents a synthesis of information that others have used to evaluate wounds in the feet of patients with diabetes, the assessment choices, objectiveness of the grading of each assessment, versatility for grading wounds of all types, and its simplicity make it unique. It meets the requirements of being easy to use and quick to obtain. The wound score is based on three grades (2, 1, or 0) for each of five assessments. The assessment items specifically were selected for their usefulness in describing the wound and helping with making of treatment decisions. A 0-point to 10-point scale with 10 being best and 0 being worst makes appreciation of the seriousness of the wound logical. The wound score works equally well for wounds in locations other than the foot, which is unique and in contrast to almost all the other diabetic foot wound scoring systems we evaluated. Initial validity and observations of reliability support its effectiveness. Finally, it helps with decision making as the starting component of a master algorithm for wound evaluation and management of problem wounds (Fig 2). The algorithm integrates with other wound and host information to provide a rational approach to evaluation, treatment, and prevention of wounds.

Another feature of the wound score is that it facilitates wound studies. Because wound scores are numbered from 0 to 10 based on highly objective information, it is easy to compare interventions and resulting outcomes of wounds with similar scores. This provides the framework for multicenter studies on products and protocols and a means to confirm further the reliability and validity of the wound score.

References

1. Apgar V: A proposal for a new method of evaluation of the newborn infant. Curr Res Anesth Analg 32:260–267, 1953.
2. Armstrong DG, Lavery LA, Harkless LB: Validation of a diabetic wound classification system: The contribution of depth, infection and ischemia to risk of amputation. Diabetes Care 21:855–859, 1998.
3. Borer KM, Borer Jr RC, Strauss MB: Prospective evaluation of a clinical wound score to identify lower extremity wounds for comprehensive wound management. Undersea Hyperb Med 27(Suppl): 34, 2000.
4. Forrest RD, Gamborg-Neilsen P: Wound assessment in clinical practice: A critical review of methods and their application. Acta Med Scand 687:69–74, 1984.
5. Foster A, Edmonds M: Simple staging system: A tool for diagnosis and management. Diabetic Foot 3:56–61, 2000.
6. Knighton DR, Ciresi KF, Fiegel VD, et al: Classification and treatment of chronic nonhealing wounds: Successful treatment with autologous platelet-derived wound healing factors (PDWHF). Ann Surg 204:322–330, 1986.
7. Lavery LA, Armstrong DG, Harkless LB: Classification of diabetic foot wounds. J Foot Ankle Surg 2:123–127, 1996.
8. MacFarlane RM, Jeffcote WJ: Classification of diabetic foot ulcers: The S(SAD) SAD system. Diabetic Foot 2:123–127, 1999.
9. Pecoraro RE, Reiber GE: Classification of wounds in diabetic amputees. Wounds 2:65–73, 1990.
10. Strauss MB, Barry DD: Vascular assessment of the neuropathic foot. Journal of Prosthetics and Orthotics 17(Suppl):535–537, 2005.
11. Strauss MB, Bryant BJ, Hart GB: Transcutaneous oxygen measurements under hyperbaric oxygen conditions as a predictor for healing of problem wounds. Foot Ankle Int 23:933–937, 2002.
12. Strauss MB, Strauss WG: Wound scoring system streamlines decision-making. BioMechanics VI:37–43, 1999.
13. Strauss MB: Diabetic foot and leg wounds: principles, management and prevention. Primary Care Reports 7:187–197, 2001.
14. Strauss MB: Hyperbaric oxygen as an adjunct to surgical management of the problem wound. In Bakker DJ, Cramer FS (eds). Hyperbaric Surgery Perioperative Care. Flagstaff, Best Publishing 383–396, 2002.
15. Strauss MB: Hyperbaric oxygen as an intervention for managing wound hypoxia: Its role and usefulness on diabetic foot wounds. Foot Ankle Int 126:15–18, 2005.
16. Strauss MB: The orthopaedic surgeon's role in the strategies for treatment and prevention of diabetic foot wounds. Foot Ankle Int 26:15–18, 2005.
17. Strauss MB, Strauss WG: Wound scoring system streamlines decision-making. Biomechanics VI:37–43, 1999.
18. Sussman C, Bates-Jensen BM (eds): Wound Care: A Collaborative Practice Manual for Physical Therapists and Nurses. Ed2. Gaithersburg, Maryland, Aspen Publishers, Inc. 103–121, 1998.
19. Treece KA, MacFarlane RM, Pound N, et al: Validation of a system of foot ulcer classification in diabetes mellitus. Diabetes Med 21:987–991, 2004.
20. Wagner Jr WF: A classification and treatment program for diabetic, neuropathic and dysvascular foot problems. Instr Course Lect 28:143–165, 1979. [Orthopaedic]