Section: General Surgery

Original Research Article

# VALIDATION OF THE LONG BEACH WOUND SCORE IN PATIENTS WITH DIABETIC FOOT ULCERS IN A TERTIARY CARE HOSPITAL IN SOUTH INDIA

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## Abstract

**Background:** None of the existing classifications and scoring system proposed for Diabetic Foot Ulcers (DFU) served full purpose, when taken into account such as communication among colleagues, fact-finding of treatment outcomes, and predicting clinical course thereby guiding treatment strategies, for daily use across different populations at all healthcare levels. Taking into account the above data, it validates the application of the Long Beach Wound Score (LBWS) for DFU assessment and management. The main objective of this study is to validate the applicability of the Long Beach Wound Score that summates five assessments using 2-point (best) to 0-point (worst) grades based on specific findings to generate a 0- to 10-point wound score for categorizing diabetic foot ulcers and to validate its effectiveness, at a tertiary care hospital in South India. **Materials and Methods:** LBWS for patients presenting with foot ulcers was calculated at the time of presentation/contact with the Point of Care. Wounds are then categorized as healthy, problem, or end-stage based on the initial LBWS. Outcomes were recorded for each healthy, problem, or end-stage category. Performance measures for sensitivity, specificity, predictive value, and accuracy were determined and analyzed for differences between the wound categories. Finally, the outcomes were computed for the healthy group combined with the problem wound categories for comparison with end-stage wound categories. **Result:** Patients in the combined problem and healthy wound groups had significantly different outcomes than those in the end-stage category (Pearson's chi-square test, P =0.0005; Fisher's exact test, P =0.0005). The performance metrics demonstrated LBWS's prediction accuracy for healing in the healthy and problem wound categories; failure in the end-stage wound category was 81.7%. **Conclusion:** With the help of the versatile Long Beach Wound Score (LBWS), Diabetic Foot Ulcers can be objectively classified as healthy, issue, or end-stage wounds. With a prediction accuracy of 81.7%, the initial LBWS indicated good outcomes for both healthy and problem wounds, and poor outcomes for end-stage wounds.

## INTRODUCTION

In India, 25% of people with diabetes have Diabetic Foot Ulcer, of which 50% are infected and need to be hospitalized and 20% require amputation. DFU accounts for over 80% of all non-traumatic amputations performed annually. Approximately half of DFU patients who undergo amputation get another one in the following two years.[1] After amputation, the death rate increases from 13% to 40% in a year to 39% to 80% in five years.[2-4] Depending on the personal factors related to the DFU patients, the risk of developing complications such as hospital admission, amputation and death is individualized.

A review by The International Working Group on the Diabetic Foot (IWGDF) states that a large number of classification and scoring systems have been proposed for Diabetic Foot Ulcers (DFU), which suggests that none is ideal for routine use in populations worldwide. This may also reflect the different purposes that the classification and scoring systems serve: clinical prognostication and treatment guidance, clinical audits of outcomes across units and populations, and communication among health professionals (regardless of the level of clinical care).[5]

A scoring system works by providing different slabs for a variety of factors involved in arriving at a final score, mostly in numbers with a high end of the score


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logically associated with good outcomes. However, a classification system is created with the intention of dividing cases into cohorts with or without relations to the degree of outcome. The content in both systems varied uniformly according to the varied dimensions of usage. An accurate validation report is required for a system to be used in situations, such as evaluating the outcomes of a patient with DFUs. If doctors in their busy schedule attending the DFU patients were seeking a user-friendly system by achieving a balance of including significant features related to outcome but excluding the parameters that have distant association with the outcome, it should contain fewer details with more significance.[6] Thus, a scoring system used to predict the outcomes has to be simple, and its ability to implement basic clinical skills is of paramount importance.

Taking into account the above data, it validates the application of the Long Beach Wound Score (LBWS) for DFU assessment and management. This validation document accomplishes two goals: it first classifies wounds as healthy, problem, or end-stage using quantitative methods. On the basis of a preliminary assessment of the wound, prompt management suggestions were offered. Second, it validated the LBWS for predicting outcomes in a prospective series of patients with DFUs at a tertiary care hospital in South India.

By integrating the LBWS into an algorithm, the evaluation and treatment of wounds become objective, measurable, and predictable in addition to being sensible (better results come from a high 0-to-10 score) and simple to use with objective findings to grade each of the five assessments on a 0-to-2 scales.[7] Furthermore, it may be used in areas other than the foot and different types of wounds. The established scoring systems do not integrate wound scoring into a coherent management algorithm. By outlining the wound features that require treatment at the time of the initial evaluation, this algorithm helps reduce delays in commencing relevant therapies and enables cost-effectiveness. It allows for the measurement of progress (or deterioration) using a 0-to10 wound scoring system. As the scores improved, the LBWS tracks improvement. A change in treatment is warranted if there is no improvement in the wound score or worsening is observed.

**Aim**

To validate the effectiveness of the Long Beach Wound Scoring System in predicting the outcomes of patients with Diabetic Foot Ulcers.

**Objective**

To study the applicability of the Long Beach Wound Score that summates five assessments using 2-point (best) to 0-point (worst) grades based on specific findings to generate a 0- to 10-point wound score for categorizing diabetic foot ulcers and to validate its effectiveness at a tertiary care hospital in South India.

## MATERIALS AND METHODS

Strauss devised a wound score, named the Long Beach Wound Score, to address the concerns raised by established scoring systems.[8-11] The LBWS uses five evaluations that are thought to be essential for assessing wounds and influencing treatment choices. On a whole number scale ranging from 0 (worst possible scenario) to 2 (best possible situation), each assessment has a highly objective element. A wound score between 0 and 10 is obtained by adding five scores. It intuitively makes sense that a circumstance with a score of 10 is ideal, and one with a score of 0 is the worst. LBWS was comparable to the Apgar Score in this regard. The Apgar Score is a 10-point rating system that is widely used to assess newborns within the first five minutes of life. This is a rapid, dynamic, and objective approach. The five assessments used to determine LBWS included (1) appearance of the wound base, (2) wound size, (3) wound depth, (4) infection, and (5) perfusion.[12] Long Beach Wound Scores of 7 to 10 points classify the wound as a Healthy, 3 to 7 points as a Problem, and 0 to 3 points as an End Stage. The interobserver reliability of the scoring method was 0.81.[13] Serial wound scoring quantifies wound progression and provides an objective method for measuring the Minimal Clinical Important Differences. Each wound category in the LBWS had an outcome accuracy of 75.3% based on the first evaluation, which was conducted prior to any in-hospital treatment of over 100 patients.[14]

LBWS for patients presenting with foot ulcers in the outpatient department and emergency room under the Department of General Surgery in Government Royapettah Hospital, Chennai, was calculated at the time of presentation/contact with the Point of Care. Wounds are then categorized as healthy, problem, or end-stage based on the initial LBWS. Healthy wounds had an LBWSs of 7 to 10 points, problem wounds had a score of 3 to 7 points, and end-stage wounds had a score between 0 and 3 points.

LBWS was then used to quantify wound changes during re-evaluation, irrespective of treatment. Patients were followed up by telephone or by analyzing outpatient follow-up charts nine months after recruitment. Patient outpatient charts were analyzed during follow-up if the patient was regular. In the case of defaulters for outpatient follow-up, patients were contacted via telephone and mail, and the outcomes were noted.

Outcomes were graded on a 0- to 2-point scale, with 2 points indicating a healed wound, 1.5 points an improved wound, 1) an unchanged wound, 0.5 point a worsening wound, and 0 points indicating lower limb amputation or death. The criteria used to label a wound as improved included the development of a healthy granulation tissue base, transition to easy- to-perform wound care, ability to resume the pre-wound level of ambulation, and amelioration of odor or discharge from the wound. Outcomes were recorded for each healthy, problem, or end-stage category.


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In addition, healed and improved wounds were labeled as good outcomes, whereas the unchanged, worsening, and amputation/death groups had poor outcomes. Performance measures for sensitivity, specificity, predictive value, and accuracy were determined and analyzed for differences between the wound categories. Finally, the outcomes were computed for the healthy group combined with the problem wound categories for comparison with the end-stage wound categories.

## RESULTS

Of the 100 patients, seven had unavailable outcome scores for the analysis. Of the remaining 93 patients who had both LBWS and outcome scores, 25(26.8%) had initial LBWSs in the healthy category, 49 in the problem category (52.6%), and 19 in the end-stage category (20.4%). 21 of the 25 patients (84%) in the healthy group showed good results, with the failures being ascribed to comorbidities and problems with compliance. Of the 49 patients in the problem category, 40 (81.6%) reported good results. Of the 19 patients in the end-stage category, four (21%) achieved good outcomes. All of the good outcomes in this group were ascribed to the prompt improvement of their LBWS following successful distal foot amputations. Overall, the outcomes were good for 65 of the 93 patients (69.8%). Performance metrics demonstrated LBWS's prediction accuracy for healing in the healthy and problem wound categories and failure in the end-stage wound category was 81.7%. Four (6.1%) of the 65 patients with good (healed or improved) outcomes had initial LBWSs that fell into the end-stage category. In contrast, 8 (28.5%) of the 28 individuals with poor outcomes (30.1%) had the initial LBWSs in the problem range. Patients in the combined problem and healthy wound groups had significantly different outcomes than those in the end-stage category (Pearson Chi-square test, P =0.0005; Fisher's exact test, P =0.0005).

**Table 1: The Long Beach Wound Score.**

| Grading/ Assessments | 2 Points | 1 Point | 0 Point |
|---|---|---|---|
| Appearance<br>(wound base) | Red | White/yellow<br>Fibrous membrane/<br>Exudate/ biofilm | Black<br>Gangrene |
| Size<br>Include undermining | <thumb print | Thumb print to fist | >fist |
| Depth<br>To end of tracts | Subcutaneous or skin coverage | Muscle/ tendon/ bursa | Bone/joint |
| Perfusion | Palpable pulses<br>Pink/ warm/ capillary refill <2 seconds | Doppler pulses<br>Dusky-pale/ cool/ capillary refill2-5seconds | Imperceptible Pulses<br>Black-cyanotic-white/ cold/ capillary refill>5 seconds |
| Infection | Normal flora or contamination | Cellulitis, osteomyelitis, maceration, exudation | Sepsis (leukocytosis, dysglycemia,+ blood cultures) |

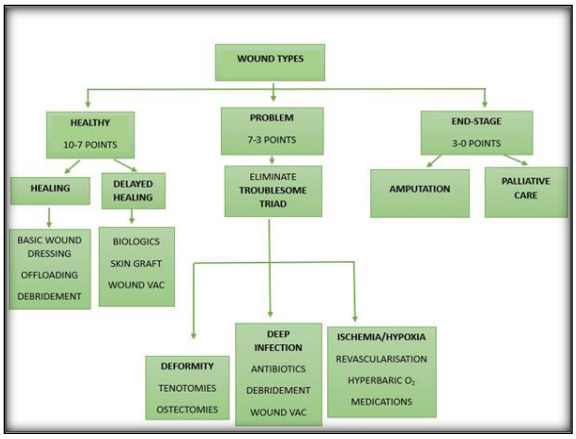


**Figure 1: Algorithm for evaluation, management and expected outcomes with management of diabetic foot ulcers**

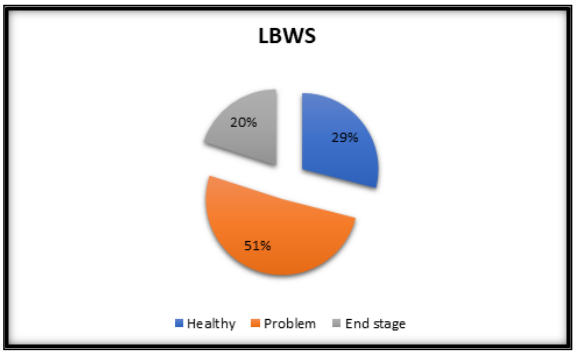


**Figure 4: LBWS distribution.**

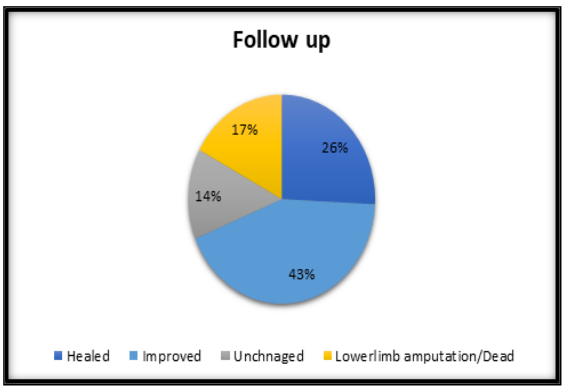


**Figure 3: Follow up distribution.**


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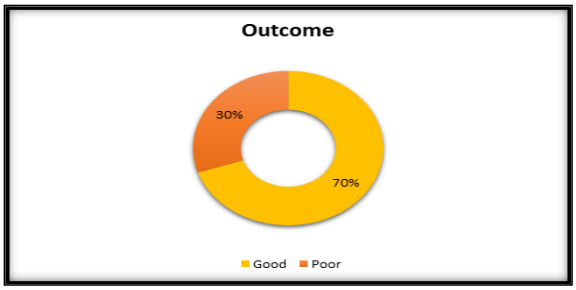


**Figure 4: Outcome distribution. For the meaningful conclusions been drawn from the follow up details of the patient, the end result is directed to two outcomes with healed, improved wounds taken as good and unchanged, amputation as poor.**

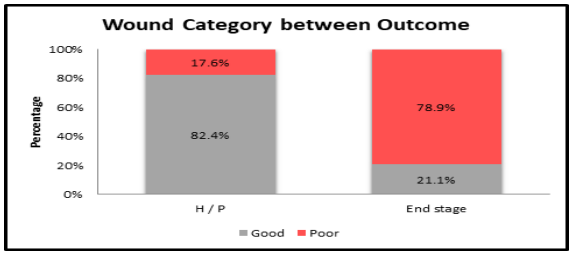


**Figure 5: Comparison of Combined Wound Category with final outcome by Fisher's exact test were □2=27.067, P=0.0005<0.01 which shows highly statistical significance association.**

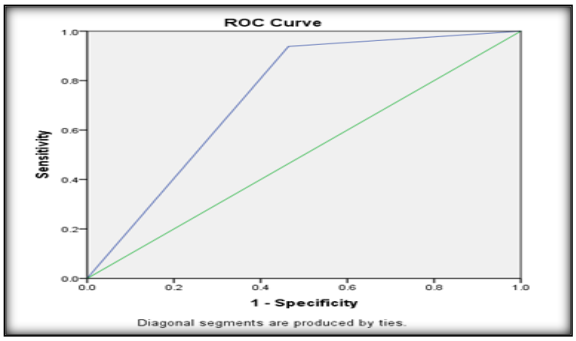


**Figure 6: Comparison of Combined Wound Category with final outcome using Receiver Operating Characteristic curve (RoC), which shows the area of the curve is 0.737, P-value= 0.0003<0.01 with 95% C.I 0.613 to 0.861, which is highly statistical significant with the Sensitivity 93.8%, Specificity 53.6%, PPV 82.4%, NPV 78.9% and accuracy 81.7%.**

## DISCUSSION

The LBWS uses objective data to generate a 0-to 10-point score that determines the severity of wounds as healthy, problem, or end-stage. It can quantify the progress (i.e. improvement or decline) with consecutive observations. This offers standards for maintaining the current management and modifying interventions. It also offers a numerical tool for Comparative Effectiveness Research and assesses the efficacy of wound dressing agents with comparable LBWS.

Underlying deformities, deep infection affecting the bone, bursa, and/or cicatrix, and hypoxia-ischemia were linked to the majority of the problem wounds in this investigation. This explains why successful results were favored by therapies such as debridement, unloading, and revascularization, when they were practical. The reasons for the poor results in the healthy wound category cohort included troublesome deformities that impeded movement and/or patient noncompliance. When wounds in the healthy category were involved, they almost always needed to be admitted for causes other than lower-extremity wounds, and their wounds did not improve during the observation period. The reason for the positive results observed in cases with end-stage wounds at the time of the initial evaluation was that the wounds were located in the forefoot and had successfully undergone distal foot or toe amputation. None of the end-stage wounds with poor outcomes could be revascularized. Successful revascularization clearly enhanced LBWS perfusion assessment and classified the wounds as either healthy or problem wounds. However, in this study, the initial LBWS was used to determine the end-stage category. The ability of this tool to predict outcomes for lower extremity wounds was validated by its high positive predictive value (82.4%) and high LBWS accuracy (81.7%). For both the combined healthy and problem wound categories, the accuracy of predicting good outcomes from initial LBWS was 82.4%. The prediction of good and poor outcomes using LBWS categories was statistically significant (Fisher's exact test, P = 0.0005). For patients hospitalized with lower-extremity wounds, this information allows clinicians to predict outcomes from the initial LBWS. There were discernible reasons for outliers deviating from the LBWS predictions. With the use of this scoring system, the evaluation of diabetic wounds became quantifiable with less inter-observer variability, and was accurate in predicting clinical outcomes. It is more logical with higher scores depicting good outcomes and user friendliness, because of its simplicity. The use of this algorithm made treatment decisions quick and mobilisation of precious health resources with care. Most wounds for which biologics are recommended fit the present group of healthy wounds. LBWS is especially useful for the problem wound category, which was able to predict good outcomes with over 80% accuracy in this study. In this group of wounds, the most significant variations between good and poor outcomes occurred with the appropriate therapy. Finally, the LBWS contribute to research work by analysing wounds with the same score in different populations and also assisted in changing the treatment course of the wound on a real-time basis by quantifying the meaningful clinical improvement achieved during the course of DFU treatment.

**Limitations:** The lack of information regarding wound treatment in this study was a limitation. Although nearly every patient was under the care of our committed surgical team, the objective of this study was to classify and grade wounds according to a preliminary assessment and track the results independently of management. Another limitation is the debate over whether the progression of healing


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alone should be considered a successful outcome in this analysis. The goal of this study was to classify wounds to predict outcomes based on LBWS while making no management recommendations nearly seems paradoxical. However, the categories of "healthy," "problem," and "end-stage" provide instant directions for the necessary interventions. For instance, simple interventions are all that are needed for healthy wounds, while a strategic management by managing the wound base through amputations, ostectomies, and/or debridement, providing the best medical care possible for the patient's comorbidities, choosing the right wound dressing agent, and reducing wound ischemia-hypoxia are necessary for problem wounds. Revascularization is nearly always necessary for end-stage wounds if lower limb amputations need to be prevented.

## CONCLUSION

With the help of the versatile Long Beach Wound Score (LBWS), Diabetic Foot Ulcers can be objectively classified as healthy, issue, or end-stage wounds. From these categories, the interventions for managing each category became obvious. The initial LBWS indicated good outcomes for both healthy and problem wounds and poor outcomes for end stage wounds, with a prediction accuracy of 81.7% in this study. Thus, the Long Beach Wound Scoring System is effective in predicting the outcomes of patients with Diabetic Foot Ulcers at a tertiary care hospital in South India.

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