

# Evaluation of Diabetic Ulcer Severity Score (DUSS) in Predicting Outcome in Patients with Diabetic Foot Ulcer

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**Abstract:** ***Background:** Diabetes is one of the most common chronic diseases affecting around 57% (diagnosed + undiagnosed) of Indians and is a cause of major co morbidity which includes the development of the diabetic foot ulcer (3). Diabetic foot ulcer in itself is a chronic disease where timely intervention when not done with adequate control would ultimately lead to amputation of the affected limb/part affecting the quality of life. Various classifications exist for evaluating the diabetic foot ulcer that compare treatment modalities and outcome (18), here we look at one-Diabetic Ulcer Severity Score (DUSS) (19) and test its efficacy in predicting the outcome of the ulcer and ultimately the limb. **Aim of the study:** To evaluate Diabetic Ulcer Severity Score (DUSS) in predicting the outcome in patients with Diabetic foot ulcer. **Material and Methods:** It is a prospective observational study in which patients admitted to the indoor facility of surgery department in GCS Medical College, Hospital and Research Centre and attending OPD with diabetic ulcer of leg during the period of January 2021 to January 2022 considering the inclusion and the exclusion criteria were included. DUSS consists of the following four parameters (4) (10): 1) Palpable pedal pulses-yes/no 2) Probing to the bone -yes /no 3) Ulcer location 4) Presence of multiple ulcerations-yes/no. With maximum score of 4 (considered poor outcome) given if all the parameters present and minimum score of 0 (good outcome) and on basis of which the outcome is predicted. **Results:** On basis of the data collected and applying the chi-square test, the data was found to be statistically significant which indicated that DUSS score is an effective method of predicting the outcome of the diabetic foot ulcer. **Conclusion:** DUSS scoring system provides an easy diagnostic tool for predicting the probability of healing or amputation by combining four clinically assessable wound-based parameters without the need of advanced investigative tool but it does not alter the procedure for wound management.*

**Keywords:** Diabetic Ulcer, Diabetic ulcer severity score, Amputation, Wound Healing

## 1. Introduction

Diabetic foot ulcer is one of the common causes of patients getting admitted in a hospital. It accounts for major morbidity and increased mortality due to the sequelae associated with it (2). Since it affects quality of life, if early intervention not done it mostly ends up in amputation of the affected part/limb (17).

Ulceration precedes amputation and is the major determinant of lower-limb amputations (16). Proper glycemic control, control of foot infections and absence of ischemia accelerate the healing of ulcers. (15)

Ulcer depth is another important determinant in the successful management of diabetic patients with foot ulcers (8).

A variety of classification systems exist incorporating different variables such as site of ulcer, its depth and association of factors like infection, ischemia and neuropathy (7).

Peripheral vascular disease, deep ulcers and the presence of other co morbidities like hypertension and addictive habits like smoking, alcoholism also influence the proper and effective management of ulcer. (9)

15-20% of diabetic patients develop foot ulcers during their life time along with significant health related issues and cause decrease in quality of life. It results in large consumption of healthcare resources (1), according to the article (International Surgery Journal *Kummankandath SA et al. IntSurg J. 2016 Aug; 3 (3): 1509-1516*)

Various scoring systems and classification of foot ulcers have been developed and are in use. For example, University of Texas, Diabetic Wound Classification system, Diabetic foot classification according to Wagner, Brodsky Depth Ischemia classification (11). For diabetic foot ulcer the most widely used ulcer classification systems are: the Wagner system (5), the University of Texas (UT) system and the Size (area, depth), Sepsis, Arteriopathy, Denervation system (S (AD) SAD). The S (AD) SAD system differs from the other two by including reference to both ulcer area and neuropathy. (14)

The above scoring systems are complex and do not help in predicting long term outcome in the patients. Diabetic Ulcer Severity Score (DUSS) addresses these shortcomings.

**Diabetic Ulcer Severity Score is a new scoring system described by Beckert et al (6).**

DUSS (Diabetic Ulcer Severity Score) is one of the newly developed wound-based system of classifying the ulcer which needs to be validated in our setup.

As this scoring system can predict amputation rates it will be a very useful tool for decision making in patients requiring amputations.

## 2. Materials and Methods

150 Diabetic patients attending surgical outpatient clinic or admitted in GCS MC & H RC from Jan 2021 to Jan 2022 were recruited into the study based on the inclusion and exclusion criteria mentioned below. The baseline demographic data which includes age, sex, occupation, education status, habits, socioeconomic status and treatment history was taken.

In patients with multiple ulcers, the wound with the highest grading were selected for analysis. For wounds with identical grading, the larger wound was chosen.

Standard treatment care was given to all these patients which included oral hypoglycemics/insulin, health education, antibiotics if necessary and regular wound care.

Study design-Prospective Observational Study  
Study Site: OPD and IPD, Department of General Surgery, GCS Medical College, hospital and research centre in the time span of January 2019 to January 2021

**Follow Up:**

-These patients were followed up in the surgical outpatient clinic twice in week for 1<sup>st</sup> month, then twice in a fortnight till the ulcer healed or for a minimum period of up to 3 months (whichever was earlier).

**Inclusion Criteria:**

- 1) Patients who had given written informed consent.
- 2) Those who underwent the investigation /procedure after detailed explanation.
- 3) Age limit: 18-80 years
- 4) All subjects suffering from Diabetes Mellitus as per WHO criteria who have foot ulcers
  - Symptoms of Diabetes + random blood sugar > 200 mg Or
  - Fasting blood sugar > 126 mg/dl
  - 2-hour plasma glucose level > 200 mg/dl
- 5) All diabetic foot ulcers irrespective of ulcer duration

**Exclusion Criteria:**

- 1) Venous stasis ulcer with diabetes mellitus
- 2) Patients with other co-morbidities.
- 3) Non diabetic foot ulcers.
- 4) Non diabetic neuropathic ulcers.
- 5) Patients who were HIV, HbsAg and HCV reactive.

**Four clinically defined parameters, namely (13)**

- 1) Palpable pedal pulses
  - 2) Ulcer probing to bone
  - 3) Location of ulcer and
  - 4) Number of ulcers
- were assessed.

Based on the parameter the scores are added to give a maximum score of 4.

**Table 1:** The Parameters of DUSS scoring system (12):

Parameter	Score 0	Score 1
Palpable Pedal pulses	Palpable	Not Palpable
Ulcer probing to bone	Not probing	Probing
Location of ulcer	Toe	Foot
Number of ulcers	One	Multiple

**3. Observations and Results**

**3.1 Gender Wise Distribution**

In the present study we observed that majority were males (57.33%), and 42.67% were female subjects. The M: F ratio observed in the present study was 1.34: 1.

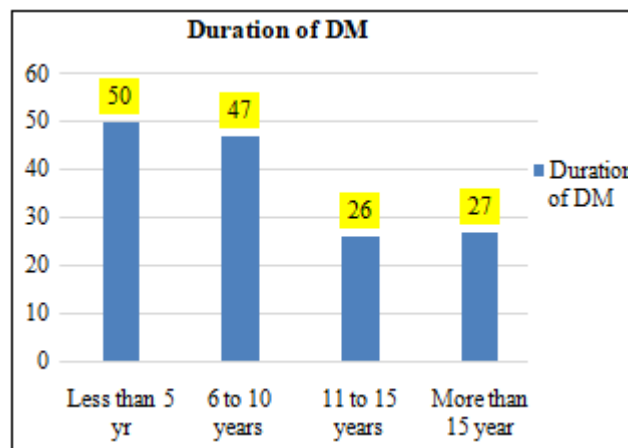
**Table 2:** Gender wise Distribution.

Gender	Number of subjects	Percentage
Male	86	57.33
Female	64	42.67
Total	150	100.00

The age wise distribution of the subjects was seen to be as below table.

**Table 3:** Age wise distribution of the subjects

Age	Number of subjects	Percentage
Less than 30 years	5	3.33
31 to 40 years	33	22.00
41 to 50	32	21.33
51 to 60	37	24.67
More than 60 years	43	28.67
Total	150	100.00



**Figure 1:** Duration of diabetes mellitus

The duration of the diabetes mellitus in the subjects was seen as below graph.

Study subjects were classified according to the site of ulcer. It was observed that toes were the commonest site (51.33%), followed by foot among 48.67% study subjects.

**Table 5:** Site of ulcer

Site of ulcer	Number of subjects	Percentage
Foot	73	48.67
Toes	77	51.33
Total	150	100.00

We observed that majority of the subjects presented with single ulcer at the time of presentation (58%), while 42% subjects presented with multiple ulcers.

**Table 6:** Number of ulcers

Number of ulcers	Number of subjects	Percentage
Single	87	58.00
Multiple	63	42.00
Total	150	100.00

In the present study we assessed the probing to bone. We observed that it was present among 40.67% study subjects, and absent among 59.33% study subjects.

**Table 7: Probing to bone.**

Probing to bone	Number of subjects	Percentage
Yes	61	40.67
No	89	59.33
Total	150	100.00

We observed that among 59.33% study subjects, the pedal pulses were found palpable. While among 40.67% subjects it was not found palpable.

**Table 8: Presence/Absence of palpable pedal Pulses.**

Palpable Pedal pulses	Number of subjects	Percentage
Presence	89	59.33
Absence	61	40.67
Total	150	100.00

We observed that majority of the study subjects had DUSS score 1 (40.67%), followed by DUSS score 2 (36.67%), 3 (11.33%), 4 (6%) and DUSS score 0 (5.33% subjects).

**Table 9: Classification of patients based on DUSS SCORE**

DUSS Score	Number of subjects	Percentage
0	8	5.33
1	61	40.67
2	55	36.67
3	17	11.33
4	9	6.00
Total	150	100.00

In this study we also assessed the outcomes among the study subjects according to their DUSS score. Initially we assessed outcomes among subjects with DUSS score 0. We observed that all subjects with DUSS score 0 were healed without any complications.

**Table 10: Outcome of patient's with DUSS SCORE 0.**

Score 0	Number of subjects	Percentage
Healed	8	100.00
Debridement with STSG dressings	0	0.00
Minor Amputation	0	0.00
Major Amputation	0	0.00
Total	8	100.00

In the present study we assessed the outcomes among the study subjects presented with DUSS score 1. We observed that 75.41% subjects were healed, while 16.39% subjects required debridement with STSG dressings, and minor amputations were required among 8.20% study subjects.

**Table 11: Outcome of the patients with DUSS SCORE 1**

Score 1	Number of subjects	Percentage
Healed	46	75.41
Debridement with STSG dressings	10	16.39
Minor Amputation	5	8.20
Major Amputation	0	0.00
Total	61	100.00

We observed that 54.55% subjects were healed, while 18.18% subjects required debridement with STSG dressings, and minor amputations were required among 27.27% study subjects.

**Table 12: Outcome of the patients with DUSS SCORE 2**

Score 2	Number of subjects	Percentage
Healed	30	54.55
Debridement with STSG dressings	10	18.18
Minor Amputation	15	27.27
Major Amputation	0	0
Total	55	100

We observed that only 11.76% subjects were healed, while 17.65% subjects required debridement with STSG dressings, and minor amputations were required among 47.06% study subjects, and major amputations were required among 23.53% study subjects.

**Table 13: Outcome of the patients with DUSS SCORE 3**

Score 3	Number of subjects	Percentage
Healed	2	11.76
Debridement with STSG dressings	3	17.65
Minor Amputation	8	47.06
Major Amputation	4	23.53
Total	17	100

We observed that none of the subjects were healed or required debridement with STSG dressings. 44.44% study subjects required minor amputations, and major amputations were required among 55.56% study subjects.

**Table 14: Outcome of the patients with DUSS SCORE 4**

Score 4	Number of subjects	Percentage
Healed	0	0
Debridement with STSG dressings	0	0
Minor Amputation	4	44.44
Major Amputation	5	55.56
Total	9	100

In the present study we compared the DUSS score with the various outcomes such as healing, debridement with STSG dressing, minor and major amputations. We observed that as the DUSS score increases the probability of amputation increases and lesser is the DUSS score better is the prognosis. Using Chi-square test, the difference was found to be statistically significant.

**Table 15: Comparison between DUSS SCORE and OUTCOMES**

DUSS score	Healed	Debridement with STSG	Amputation	Total
0	8	0	0	8
1	46	10	5	61
2	30	10	15	55
3	2	3	12	17
4	0	0	9	9
Chi-square statistic-31.4187. p-value-< 0.00001. Result significant at p <.05.				

Beckert et al reported primarily healing of 74% (n=1, 000), Prompers et al (33)77% (18) (n=1, 229), Oyibo et al (34) 65% (n=194) (3), Jeffcoate et al (35)66% (n=449) (16) and Gul et al (36) 72% (n=200) (18).

In the original study by Beckert et al (10), Patients with a score of 0 had no risk of major amputation, while patients

with a score of 1 had a 2.4%, patients with a score of 2 had a 7.7%, patients with a score of 3 had an 11.2%, and patients with a score of 4 had a 3.8%. (4)

#### 4. Conclusions

We conclude that as the DUSS (1-4) score increases, the probability of amputation increases and lesser is the DUSS score better is the prognosis.

DUSS scoring system provides an easy diagnostic tool for predicting probability of healing or amputation by combining four clinically assessable wound-based parameters. Study groups can be stratified depending on severity of ulcers and thus can help provide a simple, streamlined approach in clinical setting without need of any advanced investigative tool, but it does not alter the procedure of wound management.

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