

Validation of New Wound Based Diabetic Ulcer Severity Score (DUSS)

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Abstract

Context: Diabetic ulcer severity score (DUSS) was by Beckert considering palpable pedal pulses, probing to bone, ulcer location and presence of ulcerations assess outcome.

Aims: To calculate DUSS in the patients with diabetic foot and assess the outcome.

Settings and Design: A single center Prospective Analytical study in Tertiary care center among 150 Diabetic patients of 20–80 years with foot ulcers

Methods and Material: Medical history, physical examination, investigation results are entered into data collection forms. Patients were followed for 6 months.

Statistical Analysis used: Median and inter quartile range, Kaplan-Meier Analysis, Cox regression.

Results: Mean age was 53 ± 14 years. Males were 58%. DUSS 3 score was common, 50.66% had amputations. The probability of healing with Score 0 was 93.75%, 92.86% with Score 1, 75% with Score 2, 15% with Score 3 and 0% with Score 4.

Conclusions: DUSS scoring system provides an easy diagnostic tool for anticipating probability of healing/ amputation and need for surgery by combining four clinically assessable wound based parameters.

Keywords: DUSS score; Amputation; Skin grafting; Secondary healing.

Introduction

Foot ulcers are a common complication of diabetes and represent a major source of morbidity. The incidence of foot ulcers with diabetes is around 2% per year.¹ Fifteen percent of diabetics develop foot ulcers during their life time with significant health related decrease in quality of life and consumption of a great deal of healthcare resources.²

Foot ulceration occurs as a combination of many contributing factors like peripheral neuropathy, peripheral vascular disease, foot deformities, external trauma and peripheral edema. Most commonly due to peripheral neuropathy, foot deformity and trauma.³ Up to 70% all non-traumatic amputations in the world occur in diabetics.⁴ Many of these amputations are preventable as 85% are preceded by a foot ulcer.

Many classification systems for diabetic foot ulcers have been proposed in the past. Some are based on extensive diagnostic work up and complex grading or scoring schedules, while others do not include all diabetic foot complications. Several attempts have been made to establish classification systems that help to assess the severity of disease.

A clinical severity score is considered to be superior to a classification system because, a clinical severity score should be based on a standardized clinical assessment of wound-based parameters facilitating the categorization of wounds into specific severity subgroups for comparison of outcome with respect to the clinical course of wound repair.

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A severity scoring system called Diabetic ulcer severity score (DUSS) was designed by Beckert et al.³ considering the four clinically defined parameters, namely palpable pedal pulses, probing to bone, ulcer location and presence of multiple ulcerations to outcome this problem, and have found that healing was independently associated with Peripheral arterial disease, ulcer depth & site and ulcer number.

According to Beckert et al.³ a lower DUSS score was strongly associated with healing and it is simple, provides an easy diagnostic tool for predicting probability of healing or amputation, which can be applied in daily clinical practice without need of any advanced investigative tool. Diabetic Ulcer Severity Score is one of the latest simple wound based clinical score which needs to be evaluated for its effectiveness in predicting the outcome of foot ulcers in patients with diabetes.

This study was undertaken to analyse the efficacy of DUSS scoring system in diabetic foot ulcers for prediction of clinical outcomes on the patients and its applicability in day-to-day practice in tertiary care hospital, as the prevalence of diabetes and diabetic foot ulcers is more in our part.

Materials and Methods

Study Area and Population: The patients with diabetic foot attending to surgical outpatient clinic or admitted in Tertiary Care Hospital.

Study Design: A single centre Prospective Analytical study

Sample Size: Sample size for the present study was calculated based on the formula and it was 150. Sample Size (SS) = $Z\alpha/2^2 * (p) * (1-p)/C^2$

Inclusion criteria

1. Male and female patients between age group 20-80 years.
2. All patients suffering from diabetes mellitus who had foot ulcers

Exclusion criteria

1. Venous stasis ulcers with Diabetes mellitus.
2. All patients with less than two follow-up visits during observation period.
3. Ulcers above the ankle.

Sampling Procedure: All eligible patients, who are satisfying inclusion and exclusion criteria are included in the study, hence no sampling is done.

Study Duration: February 2015 to October 2016.

Data Collection Methods: After admission, data for the study is collected from the medical records and from the patients included in the study. Direct interview with patient or patient's relatives/bystanders and obtaining history. Clinical examination-general condition, Pulse rate, respiratory rate, Blood pressure & Temperature. Investigations-Complete blood count & relevant investigations depending on further evaluation.

Data Collection Forms: All the data pertaining to the research, Including the medical history, physical examination, investigation results are entered into data collection forms.

Ulcers were labelled infected if a purulent discharge was present with two of the local signs mentioned below. Wound depth was evaluated using a sterile blunt probe. The ability to probe to bone with the presence of local inflammation (warmth, erythema, lymphangitis, lymphadenopathy, edema, pain) or signs of systemic infection and suggestive radiological features provided a clinical diagnosis of osteomyelitis.

Peripheral vascular disease was clinically detected by the absence of both pedal pulses, patients were categorized into groups having either single or multiple ulcerations on the same foot. In patients with multiple ulcers, the wound with the highest grading was selected for Analyzis. For wounds with identical grading, the larger wound was chosen. Unhealed ulcers were followed up for a minimum period of 6 months. Once a patient's ulcer had healed completely either by primary healing or skin grafting or a lower-limb amputation performed, the outcome was noted and the patient was deemed to have completed the study.

Diabetic Ulcer Severity Score (DUSS): Ulcers were Scored by the below mentioned variables. Diabetic Ulcer Severity Score (DUSS) was calculated by adding these separate scored variables to a theoretical maximum of 4.

Variables	Score 0	Score 1
Palpable Pedal pulses	Presence	Absence
Probing to bone	No	Yes
Ulcer site	Toes	Foot
Ulcer number	Single	Multiple

Healing was defined as complete epithelisation or healing after skin grafting. Amputation rate was defined as the percentage of patients undergoing either minor or major amputation within the observation period. Toe or forefoot amputations were taken as minor amputation and below- or above-knee amputation were taken as major amputation.

Follow-up: Dressings were done every day but, these patients were followed up in the surgical outpatient clinic for DUSS scoring once in fortnight for 1st month, then once in a month till the ulcer healed or for a minimum period of up to 6 months. Ulcer healing was assessed as mentioned earlier.

Statistical Analysis: A descriptive statistics based on the study on "DUSS" was analyzed and expressed in percentages. Baseline characteristics were expressed as median and inter quartile range. Kaplan-Meier method was used to calculate the probability of healing. Cox regression was used to find the correlation between DUSS and healing.

Results

Most common age group affected with Diabetic foot was between 36–50 years, second group being between 51–65 years. Mean age group was 53 ± 14 years. Median age was 52.5 (IQR = 40 to 65 years). Males were more affected by Diabetic foot ulcers i.e. 58% in our study.

Table 1: Age-wise distribution of study population

Age distribution in years	No of patients	Percentage (%)
21–35	21	14.0
36–50	49	32.7
51–65	46	30.7
66–80	34	22.7
Total	150	100.0

Table 2: Distribution of DUSS score among study population

DUSS score	Number of patients	Percentage (%)
0	16	10.7
1	28	18.7
2	36	24.0
3	40	26.7
4	30	20.0
Total	150	100.0

Table 3: Amputation distribution among study population

Amputation	Number of Patients	Percentage (%)
Done	76	50.66
Not Done	74	49.34
Total	150	100.00

Table 4: Distribution of type of amputations among study group

Amputation	No. of patients	Percentage
Major	30	20.00
Minor	46	30.67
Total	76	50.67

Table 5: Major amputation among the study population

Amputation		Major	
		No. of Patients	Percentage (%)
Done	Above Knee	7	4.7
	Below Knee	23	15.3
Not Done		120	80.0
	Total	150	100.0

Above Knee Amputation was done in 5% of the population while Below Knee Amputation was done in 15% of population.

Minor Amputation was done for 30.7% in

our study. Fore Foot Amputation was done in 25% of the population while Toe Amputation was done in 6% of population.

Table 6: Minor amputation among the study population

Amputation	Minor		
	No. of Patients	Percentage (%)	
Done	Fore Foot	37	24.7
	Toe	9	6.0
Not Done		104	69.3
Total		150	100.0

Table 7: Pattern of ulcer healing with DUSS Score 0 in each follow-up visit $n = 16$

DUSS score	Follow-up visits	Healed	Amputation	Not healed
		n (%)	n (%)	n (%)
0	1	0 (0%)	0 (0%)	16 (100%)
	2	10 (62.5%)	0 (0%)	6 (37.5%)
	3	2 (33.3%)	0 (0%)	4 (66.7%)
	4	3 (75%)	1 (25%)	0 (0%)
	5	0 (0%)	0 (0%)	0 (0%)
	6	0 (0%)	0 (0%)	0 (0%)
	7	0 (0%)	0 (0%)	0 (0%)

Ten (62.5%) ulcers out of 16 got healed by 2nd follow-up, 2 healed by 3rd follow-up and remaining

3 healed by 4th follow-up and 1 underwent amputation during 4th follow-up.

Table 8: Pattern of ulcer healing with DUSS Score 1 in each follow-up visit $n = 28$

DUSS score	Follow-up visits	Healed	Amputation	Not healed
		n (%)	n (%)	n (%)
1	1	0 (0%)	0 (0%)	28 (100%)
	2	0 (0%)	0 (0%)	28 (100%)
	3	17 (60.7%)	0 (0%)	11 (39.3%)
	4	7 (63.6%)	1 (9.1%)	3 (27.3%)
	5	1 (33.3%)	0 (0%)	2 (66.7%)
	6	1 (50%)	1 (50%)	0 (0%)
	7	0 (0%)	0 (0%)	0 (0%)

Majority of ulcers i.e. 17 (60.7%) healed by 3rd follow-up, 7 got healed by 4th follow-up, 1 healed by 5th follow-up and remaining 1 healed by 6th

follow-up, 1 underwent amputation during 4th and 6th follow-up visits respectively.

Table 9: Pattern of ulcer healing with DUSS Score 2 in each follow-up visit $n = 36$

DUSS score	Follow-up visits	Healed	Amputation	Not healed
		n (%)	n (%)	n (%)
2	1	0 (0%)	0 (0%)	36 (100%)
	2	0 (0%)	0 (0%)	36 (100%)
	3	6 (16.67%)	1 (2.77%)	29 (80.6%)
	4	17 (58.6%)	2 (6.89%)	10 (34.5%)
	5	4 (40%)	5 (50%)	1 (10%)
	6	0 (0%)	1 (100%)	0 (0%)
	7	0 (0%)	0 (0%)	0 (0%)

Six (16.67%) ulcers out of 36 healed by 3rd follow-up, 17 healed by 4th follow-up, 4 healed by 5th follow-up, 1 underwent amputation by 3rd

follow-up, 2 underwent amputation by 4th follow-up, 5 underwent amputation by 5th follow-up, 1 underwent amputation by 6th follow-up.

Table 10: Pattern of ulcer healing with DUSS Score 3 in each follow-up visit $n = 40$

DUSS score	Follow-up visits	Healed	Amputation	Not healed
		n (%)	n (%)	n (%)
3	1	0 (0%)	0 (0%)	40 (100%)
	2	0 (0%)	0 (0%)	40 (100%)
	3	0 (0%)	0 (0%)	40 (100%)
	4	1 (2.5%)	11 (27.5%)	28 (70.0%)
	5	2 (5%)	16 (57.2%)	10 (35.7%)
	6	2 (2.0%)	5 (50.0%)	3 (30.0%)
	7	1 (2.5%)	2 (66.7%)	0 (0%)

One (2.5%) ulcer out of 40 healed by 4th follow-up, 3 healed by 5th follow-up, 2 healed by 6th follow-up, 1 healed by 7th follow-up. 11 underwent amputation

by 4th follow-up, 15 underwent amputation by 5th follow-up, 5 underwent amputation by 6th follow-up, 2 underwent amputation by 7th follow-up.

Table 11: Pattern of ulcer healing with DUSS Score 4 in each follow-up visit $n = 30$

DUSS score	Follow-up visits	Healed	Amputation	Not healed
		n (%)	n (%)	n (%)
4	1	0 (0%)	0 (0%)	30 (100%)
	2	0 (0%)	0 (0%)	30 (100%)
	3	0 (0%)	0 (0%)	30 (100%)
	4	0 (0%)	6 (20%)	24 (80%)
	5	0 (0%)	12 (40%)	12 (40%)
	6	0 (0%)	11 (36.7%)	1 (3.3%)
	7	0 (0%)	1 (3.3%)	0 (0%)

All the ulcers with DUSS Score 4 underwent amputation, 6 of them by 4th follow-up, 12 by 5th follow-up, 11 by 6th follow-up and 1 underwent amputation by 7th follow-up.

The above Tables 7-11 showed that ulcers with lower score healed earlier when compared to those ulcers with higher scores. Majority of ulcers with Score 0 healed by the end of 2nd follow-up, most ulcers with Score 1 healed by 3rd or 4th follow-up, most ulcers with Score 2 healed by 5th follow-up.

Patients with Score 3, One healed and 11 underwent amputation by 4th follow-up, 2 healed and 16 underwent amputation by 5th follow-up, 2 healed and 5 underwent amputation by 6th follow-up, 1 healed and 2 underwent amputation by 7th follow-up.

All the ulcers with Score 4 underwent amputation, 6 of them by 4th follow-up, 12 by 5th follow-up, 11 by 6th follow-up and 1 underwent amputation by 7th follow-up.

Table 12: Comparison of DUSS score with amputation (major + minor)

DUSS Score	Amputation	
	Done	Healed Ulcers
	n (%)	n (%)
0	1 (6.3%)	15 (93.8%)
1	2 (7.1%)	26 (92.9%)
2	9 (25%)	27 (75%)
3	34 (85%)	6 (15%)
4	30 (100%)	0 (0.0%)
Total	76 (50.66%)	74 (49.34%)

For DUSS Score 0, 1, 2 number of persons with Healed ulcers is more while for DUSS Score 3, 4 number of persons with Amputation done is more.

Chi-Square Test

H₀: There is no association between DUSS score and Amputation

H₁: There is association between DUSS score and Amputation

$$\chi^2 = 95.63, df = 4, p < 0.001$$

Here, *p*-value < 0.001 we can conclude that there is an association between DUSS score and Amputation.

Total of 2 (5.6%) of 36 people with Score 2 had major amputations; 9 (22.5%) out of 40 people with Score 3 had major amputations and 19 (63.3%) out of 30 people with Score 4 had major amputations in our study. None of the patients with Score 0 & 1 had major amputation.

Table 13: Comparison of DUSS score with major amputation

DUSS score	Major amputation	
	Done	Not done
	<i>n</i> (%)	<i>n</i> (%)
0	0 (0%)	16 (100.0%)
1	0 (0%)	28 (100.0%)
2	2 (5.6%)	34 (94.4%)
3	9 (22.5%)	31 (77.5%)
4	19 (63.3%)	11 (36.7%)
Total	30 (20.0%)	120 (80.0%)

Chi-Square Test

H₀: There is no association between DUSS score and Major Amputation

H₁: There is association between DUSS score and Major Amputation

$$\chi^2 = 51.059, df = 4, p\text{-value} < 0.0001$$

Here, *p*-value < 0.001 we can conclude that there is an association between DUSS score and Major

Amputation.

One (6.3%) of 16 patients with Score 0 had minor amputation; 2 (7.1%) of 28 patients with Score 1 had minor amputation, 7 (19.4%) of 36 patients had minor amputation with Score 2, 25 (62.5%) of 40 patients with Score 3 had minor amputations and 11 (36.7%) of 30 patients with Score 4 had minor amputations. Minor Amputations were more common in patients with DUSS Score of 3 in our study.

Table 14: Comparison of DUSS score with minor amputation

DUSS score	Minor amputation	
	Done	Not done
	<i>n</i> (%)	<i>n</i> (%)
0	1 (6.3%)	15 (93.8%)
1	2 (7.1%)	26 (92.9%)
2	7 (19.4%)	29 (80.6%)
3	25 (62.5%)	15 (37.5%)
4	11 (36.7%)	19 (63.3%)
Total	46 (30.7%)	104 (69.3%)

Chi-Square Test

H₀: There is no association between DUSS score and Minor Amputation

H₁: There is association between DUSS score and Minor Amputation

$$\chi^2 = 33.48, df = 4, p\text{-value} < 0.00001$$

Here, *p*-value < 0.001 we can conclude that there is an association between DUSS score and Minor Amputation.

Toe amputation was done in total 9 (14.4%) out of 150 patients. One (6.25%) patients with DUSS Score 0, 2 (7.14%) patients with Score 1, 6 (16.67%) of patients with DUSS Score 2.

Fore foot amputation was done in total of 37 (24.67%) of patients. None of the patients with DUSS Score 0 and 1, 1 (2.78%) of patients with DUSS Score 2, 25 (62.5%) of patients with DUSS Score 3, 11 (36.7%) of patients with Score 4 had forefoot amputations.

Below knee amputation was done in total of 23 (15.3%) of patients.

None of the patients with DUSS Score 0 and 1,

2 (5.6%) of patients with DUSS Score 2, 9 (22.2%) of patients with Score 3, 12 (40%) of patients with Score 4 had below knee amputations.

Above knee amputation was done in total of 7 (4.6%) of patients. None of the patients with DUSS Score 0, 1, 2 and 3, 7 (23.3%) of patients with DUSS Score 4 had above knee amputations. There were no revision amputations in our study.

Table 15: Comparison of DUSS score with types of amputation

DUSS score	Toe Amputation	Fore Foot Amputation	Above Knee Amputation	Below Knee Amputation
	n (%)	n (%)	n (%)	n (%)
0	1 (6.25%)	0 (.0%)	0 (.0%)	0 (.0%)
1	2 (7.14%)	0 (.0%)	0 (.0%)	0 (.0%)
2	6 (16.67%)	1 (2.78%)	0 (.0%)	2 (5.57%)
3	0 (0%)	25 (62.5%)	0 (0%)	9 (22.2%)
4	0 (0%)	11 (36.67%)	7 (23.33%)	12 (40%)
Total	9 (6%)	37 (24.67%)	7 (4.67%)	23 (15.33%)

Chi-Square Test

H₀: There is no association between DUSS score and Type of Amputation

H₁: There is association between DUSS score and Type of Amputation

$$\chi^2 = 72.38, df=4, p\text{-value} < 0.00001$$

Here, *p*-value < 0.001 we can conclude that there

is an association between DUSS score and Type of Amputation.

Majority of foot ulcers among study population with DUSS Score 0, 1 and 2 healed by secondary healing or split skin grafting. However among those with Score 3 and Score 4 majority required amputation i.e., 33 (82.5%) and 30 (20.0%) respectively.

Table 16: Distribution of ulcers (DUSS Score 0-4) with study endpoints

DUSS score	Secondary healing	SSG	Amputation	Total
	n (%)	n (%)	n (%)	n (%)
0	13 (81.3%)	2 (12.5%)	1 (6.3%)	16 (100.0%)
1	25 (89.9%)	1 (3.6%)	2 (7.1%)	28 (100.0%)
2	1 (2.7%)	26 (72.3%)	9 (25.0%)	36 (100.0%)
3	0 (0%)	6 (15%)	34 (85%)	40 (100.0%)
4	0 (0%)	0 (0%)	30 (20.0%)	30 (100.0%)
Total	39 (26%)	35 (23.3%)	76 (50.6%)	150 (100%)

Chi-Square Test:

H₀: There is no association between DUSS score and Study Endpoints *H₁*: There is association between DUSS score and Study Endpoints

$$\chi^2 = 181.09, df = 8, p < 0.001.$$

Here, *p*-value < 0.001 we can conclude that there

is an association between DUSS score and Study Endpoints.

Majority of foot ulcers among study population with DUSS Score 0, 2, 3 and 4 are with >11 years (37.5%), (38.9%), (40%) and (36.7%) respectively while for DUSS Score 1 majority is duration 6-10 years (50.0%).

Table 17: Distribution of ulcers (DUSS Score 0-4) with duration of Diabetes

DUSS score	Duration of Diabetes (n)				
	1-5 yrs	6-10 yrs	11-15 yrs	16-20 yrs	21-25yrs
0	5	5	4	1	1
1	8	14	0	5	1
2	9	13	8	4	2
3	11	13	10	5	1
4	9	10	5	5	1

Table 18: Distribution of ulcers (DUSS Score 0-4) with duration of Diabetes

DUSS score	Duration of Diabetes			Total
	1-5 yrs n (%)	6-10 yrs n (%)	>11 yrs n (%)	
0	5 (31.3)	5 (31.3)	6 (37.5)	16
1	8 (28.6)	14 (50.0)	6 (21.4)	28
2	9 (25.0)	13 (36.1)	14 (38.9)	36
3	11 (27.5)	13 (32.5)	16 (40.0)	40
4	9 (30.0)	10 (33.3)	11 (36.7)	30

Chi-Square Test

H₀: There is no association between DUSS score and Duration of Diabetes

H₁: There is association between DUSS score and Duration of Diabetes

$$\chi^2 = 3.94, df = 8, p\text{-value} = 0.87.$$

Here, $p\text{-value} > 0.05$ we can conclude that there

is no association between DUSS score and Duration of Diabetes.

Overall DUSS Score is significant (i.e. $p\text{-value} < 0.0001$). In terms of levels, considering DUSS Score 0 as reference, DUSS Score 2 and 3 are significant.

The probability of healing with Score 0 was 93.75%, 92.86% with Score 1, 75% with score2, 15% with Score 3 and 0% with Score 4.

Table 19: Cox Regression Analyzis for DUSS scores

DUSS score	Coefexp (coef)	se (coef)	z	Pr (> z)
-1.1175	0.3271	0.1076	-10.38	<2e-16
DUSS score	exp (coef)	lower .95	upper .95	
0.3271	3.057	0.2649	0.4039	
DUSS Score	p-value	95.0% CI for Exp (B)		
		Lower	Upper	
0				
1	0.23981	0.354074	1.29665	
2	0.00011	0.146495	0.53284	
3	7.27E-12	0.009105	0.07363	
4	0.99576	0	Inf	

Table 20: Kaplan-Meier Analyzis for DUSS scores Case processing summary

DUSS Score	Total N	N of Events	Censored	
			N	Percent %
0	16	1	15	93.75
1	28	2	26	92.86
2	36	9	27	75.00
3	40	34	6	15.00
4	30	30	0	0.00
Overall	150	76	74	49.33

Chi-Square Test

H₀: There is no significant difference between healing times across the levels of DUSS Scores

H₁: There is significant difference between healing

times across the levels of DUSS Scores

$$\chi^2 = 147, df = 4, p\text{-value} = 0.00000001$$

Here $p\text{-value} < 0.0001$ we can conclude that there is significant difference between healing times across the levels of DUSS Scores.

Table 21: Median of Survival Time for DUSS scores

DUSS score	N	Events	Median	0.95 LCL	0.95 UCL
0	16	15	28	24	74
1	28	26	55	50	75
2	36	27	85	76	88
3	40	6	163	130	NA
4	30	0	NA	NA	NA

Table 22: Log rank or Mantel Hansel Test

DUSS Score	N	Observed	Expected	(O- E) ² /E	(O- E) ² /V
0	16	15	3.09	46.01	49.67
1	28	26	7.72	43.33	51.55
2	36	27	16.14	7.31	9.74
3	40	6	26.19	15.56	25.16
4	30	0	20.87	20.87	30.48

Chi-Square Test

H₀: There is no significant difference between healing times across the levels of DUSS Scores

H₁: There is significant difference between healing

times across the levels of DUSS Scores

$$\chi^2 = 138, df = 4, p\text{-value} = 0.00000001$$

Here $p\text{-value} < 0.0001$ we can conclude that there is significant difference between healing times across the levels of DUSS Scores.

Table 23: Wilcoxon Test

DUSS	N	Observed	Expected	(O- E) ² /E	(O- E) ² /V
0	16	13.10	2.57	43.20	54.97
1	28	20.97	6.53	31.89	44.56
2	36	18.79	12.76	2.86	4.73
3	40	3.18	19.12	13.29	26.95
4	30	0	15.06	15.06	27.91

Discussion

In our study, most common age group affected with Diabetic foot was between 36–50 years. Mean age group was 53 ± 14 years. Median age was 52.5 (IQR = 40 to 65 years). Males were more affected by Diabetic foot ulcers i.e. 58% in our study.

In study done by Harindranath H. R et al.⁵ of 226 patients, 61.5% were male and 38.5% were female, mean age of presentation being 62 years.

In Mohit Sharma et al.,⁶ study among 100 patients 68 were Male & 32 were Female and mean age of presentation being 70 years. In Kummarkandath

SA et al.⁷ study most common age group affected with diabetic foot was between 51–60 years. Mean age group was 54.6 ± 12.4 years. 59% of them were males affected by diabetic foot ulcers.

In Kumar ST et al.⁸ study out of 100 patients 81 were male and 19 female. Most common age group affected with diabetic foot was 51–60 years with mean age of study group was 57 ± 12 years. In Shashikala et al.⁹ study among 100 patients 68 were male & 32 were female and mean age of presentation being 52 ± 2 years. In Beckert et al.³ study of 1000 patients, 67.5% were male and 32.5% were female, mean age of presentation being 69 years.

Most commonly ulcers in the present study were of DUSS score of 3 followed by Score 2 in the study. 50.67% (76) patients underwent amputation of which 20% (30) patients had Major amputations which was nearly equal to Kummarkundath SA et al.⁷ study (18.5%), but Shashikala et al.⁹ study results showed 25% patients who had major amputation. however, on the other side Beckert et al.³ and kumar ST. et al.⁸ studies showed lesser incidence, 2.6% and 11% respectively in major amputations compared to present study.

Forty-six (30.7%) cases had minor Amputations in the present study which was significantly high compared to Beckert et al.³ (9.9%) and Shashikala et al.⁹ (27%), however it was low when compared to other studies Kummarkundath SA et al.⁷ (35%), Kumar ST. et al.⁸ (34%). The differences in incidence might be due to variation in diabetic population, geographical distribution and other risk factors in the selected population in the respective studies.

Most of the patients with DUSS 3 & 4 underwent amputations in the present study similar to other studies. In present study with zero DUSS score there was 6.3% of amputation, whereas no amputations with other studies. With DUSS Score 2 there was 25% amputations in present study similar to Kumar ST et al.,⁸ slightly higher to Mohit sharma et al.⁶

(22.2%) and lower compared to Kummarkundath SA et al.⁷ (30.5%). 7.1% amputations were observed in present study with DUSS Score 1 whereas it was 9.4% in Kumar ST et al.⁸ study & higher results were observed in Kummarkundath SA et al.⁷ (24.2%) study and were no amputations in Mohit sharma et al.⁶ study with DUSS Score 1.

Most of the patients with DUSS Score 3 & 4 underwent major amputation in the present study similar to other studies, except with the original study (Beckert et al.³) showed an unexpected low major amputation rate of 3.8% associated with a DUSS score of 4. This can be explained major amputations and by the low number of patients in this subgroup. None of the patients with Score 0 & 1 had major amputation as do with other studies, but study done by Shashikala et al.⁹ showed 4.5% & 8.3% with Score 0 & 1 respectively and 2.4% with Score 1 in Beckert et al.³ study. 5.6% patients with Score 2 underwent major amputations in the present study which was found to be less compared to Kumar ST. et al.⁸ (14%), Shashikala et al.⁹ (14%) studies, whereas Mohit Sharma et al.⁶, Harindranath H.R et al.⁵ and Kummarkundath SA et al.⁷ showed null results.

In the present study too, as the DUSS score increased, the percentage of amputations increased and the percentage of ulcers healed was 49.34%.

Table 24: Comparison of DUSS Score (0-4) With Minor Amputation (%):

Score	Present study	Mohit Sharma et al. ⁶	Harindranath H.R et al. ⁵	Kumar ST. et al. ⁸	Kummarkundath SA et al. ⁷
0	6.3	0	0	0	0
1	7.1	0	0	15.90	21.2
2	19.4	22.22		66.66	33.9
3	62.5	55.56	40.2	71.42	49.2
4	36.7	34.78	37.2	42.850	40

Table 25: Comparison of DUSS Score (0-4) With Probability of Healing (Kaplan Meier Analyzis) (%)

Score	Present study	kumar ST. et al. ⁸	Kummarkundath SA et al. ⁷	Shashikala et al. ⁹
0	93.75	100	10000.00	95.0
1	92.86	84	78.79	91.6
2	75.00	19	66.10	85.7
3	15.00	0	20.34	52.6
4	0	0	5.71	28.5

Conclusion

DUSS scoring system provides an easy diagnostic tool for anticipating probability of healing/ amputation and need for surgery by combining four clinically assessable wound based parameters. It can

be very helpful for the stratification of study groups depending on severity of ulcers and it provides a simple, streamlined approach in a clinical setting without the need of any advanced investigative tool. Lower DUSS score was strongly associated with healing and higher score with amputation.

Acknowledgement: NIL

Conflict of Interest: NIL

Key Messages: DUSS score is simple, provides an easy diagnostic tool for predicting probability of healing or amputation, can be applied in daily clinical practice without need of any advanced investigative tool.

References

1. Ramsey SD, Newton K, Blough D, et al. Diabetes care 1999 Mar;22(3):382-7.
2. Wieman TJ. Principles of management: the diabetic foot. American Journal of Surgery 2005 Aug;190(2):295-99.
3. Beckert S, Witte M, Wicke C, et al. A new wound-based severity score for diabetic foot ulcers. Diabetes Care 2006 May;29(5):988-92.
4. Grayson ML, Gibbons GW, Balogh K et al. Probing to bone in infected pedal ulcers: a clinical sign of underlying osteomyelitis in diabetic patients. J Am Med Assoc 1995;273:721-3.
5. Harindranath HR, Jayaraj R, Mohan Kumar. Clinical study to evaluate diabetic ulcer severity score (DUSS) in diabetic foot ulcer. Journal of Evolution of Medical and Dental Sciences 2015;4(103):16827-9.
6. Mohit Sharma, Anil Sharma, Sita Ram Gothwa et al. Diabetic Foot Ulcers: A Prospective Study Of 100 Patients Based On Wound Based Severity Score. IOSR Journal of Dental and Medical Sciences 2014;13:79-89.
7. Kummarkandath SA, Mohammed ST, Karatparambil AA, et al. Validation of diabetic ulcer severity score. Int Surg J 2016 Aug;3(3):1509-16.
8. Kumar ST, Arava S, Pavan BM, et al. Diabetic ulcer severity score: clinical validation and outcome. Int Surg J 2016 Aug;3(3):1606-10.
9. Shashikala CK., Nandini VK, Kagwad S. Validation of Diabetic Ulcer Severity Score (DUSS). Ann. Int. Med. Den. Res 2017;3(1):SG27-SG30.