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To Study The Significance Of Diabetic Ulcer Scoring System (DUSS) In Determining Prognosis Of Diabetic Foot Ulcers

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Abstract

Introduction: A rising incidence of diabetes mellitus in developing countries like India necessitates the need for adequate management of complications of which diabetic ulcers are the most debilitating ones. Diabetic ulcer severity score is a simple screening tool for prompt diagnosis and adequate treatment of diabetic foot ulcers.

Materials And Methods: 50 patients presenting with diabetic foot ulcer were analyzed in a prospective study conducted at MGM Medical College and Hospital, Navi Mumbai. The diabetic ulcers were graded (0-4) according to parameters of the diabetic ulcer severity score (DUSS) and the outcome of these patients were correlated with DUSS.

Results: Males were more frequently affected with diabetic foot ulcers and 61-70 was the common age group affected. Majority of patients had DUSS of 1 and 2 and were subjected to debridement, amputation or skin grafting as treatment options. While all patients with a DUSS of 3 and 4 underwent amputation.

Conclusion: Patients with higher DUSS was found to strongly correlate with higher chances of amputations and increased hospitalization stay

Keywords: Diabetic foot, Diabetic ulcer scoring system, outcome of diabetic ulcer

Introduction

Diabetes mellitus is currently at a potential epidemic state in India. It is defined as a chronic disease associated with abnormally high levels of the sugar glucose in the blood. In India alone, the prevalence of diabetes is expected to increase from 31.7 million in 2000 to 79.4 million in 2030[1]

Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation. Commonly associated problems with diabetes include foot infections, ulceration and gangrene ultimately leading to limb amputations. The incidence of diabetic foot among known cases of diabetes is 15% and is the most disturbing complication among them [2,3]

The diabetic ulcer severity score (DUSS) designed by Beckert et al [4], is a wound-based scoring system includes four basic parameters, namely pedal pulses, probing to bone, ulcer location and number of ulcerations.

This scoring system is simple, non-invasive and helps in early diagnosis of high-risk patients with diabetic foot ulcers more effectively and predict the likely outcome of a diabetic foot.

Aim of this study was to significance and efficacy of DUSS as a scoring system to determine the prognosis of diabetic foot ulcers in a tertiary care hospital.

Materials And Methods

This is a prospective study, non-randomized study at MGM Medical College and Hospital, Navi Mumbai during the period of 4 months during which 50 patients with diabetes mellitus as per WHO criteria (Symptoms of Diabetes + random blood sugar > 200 mg/dl or Fasting blood sugar > 126 mg/dl and 2-hour post prandial glucose level > 200 mg/dl), history of wound confined to the foot (below ankle) irrespective of duration of the ulcer and age more than 18 years, presenting to the Out-patient department or surgical ward were included in this study. Patients with non-diabetic foot ulcers, ulcers above the foot and ulcers due to peripheral vascular diseases and venous stasis were excluded from the study.

Institutional ethics committee approval was obtained before the start of the study and a written and informed consent was obtained from all participants. Patients were evaluated for their glycemic control, prevention of sepsis using antibiotics, and wound care with dressings.

DUSS from 0-4 was calculated for every patient based on 4 parameters-

1. Presence or absence of pedal pulses
2. Probing to bone
3. Site of ulceration, toe or foot
4. Single or multiple ulcers

Based on the DUSS, the final outcome of the patient was studied and divided into amputations, surgical debridement and skin grafting

Variables	**Score 0**	**Score 1**
Palpable Pedal pulses	Present	Absent
Probing to bone	No	Yes
Ulcer site	Toes	Foot
Ulcer number	Single	Multiple

Table 1: Diabetic ulcer severity score

Statistical methods- Data collected was entered in Microsoft Excel Professional 2019, and analyzed using statistical package for social sciences (SPSS) version 20.0, IBM corporation, 2011

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Figure 1: Left diabetic wound before and after debridement

Observations And Results

Age group and sex of study population

Age group (in years)	Male	Female	Percentage
	Number (%)	Number (%)	
≤ 50	9 (75)	3 (25)	12
51 to 60	14 (100)	0	14
61 to 70	11 (64.7)	6 (35.3)	17
71 to 80	4 (57.1)	3 (42.9)	7
Total	38	12	100

Table 1: Age and sex distribution

In this study (n=50) there were 38 (76%) males and 12 (24%) females. Incidence of diabetic foot ulcer was low in ages below 50 as we had 12 (24%) cases below 50 years of age. In age group of 51-60, we had 14 patients, all were males. In age groups of 61-70, there were 11 males and 6 females and 71-80, there were 4 males and 3 females.

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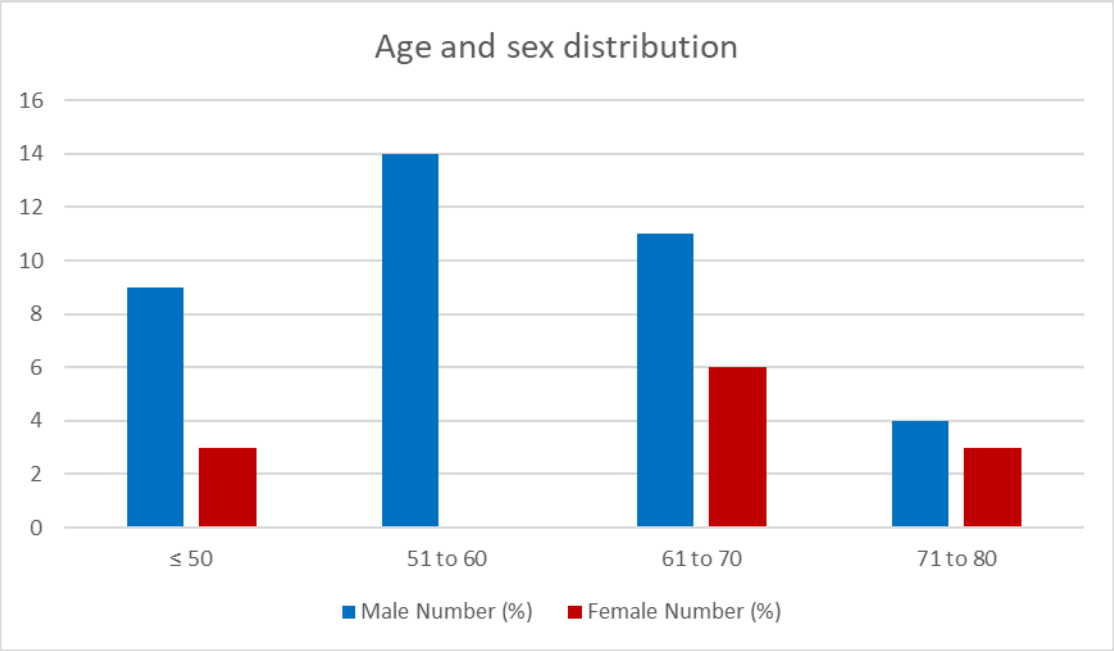

Figure 2: Age and sex distribution (N=50)

Wound duration

Wound duration	Number	Percentage (%)
Up to 7 days	**21**	**42**
8 to 30 days	**27**	**54**
31 to 90 days	**2**	**4**
Total	**50**	**100**

Table 2: Wound duration (N=50)

Average number of wound durations was 12.5 days. 21 patients had a wound duration of less than 7 days. Majority of the patients 27/50 (54%) had a wound between 8 to 30 days and only there were 1 patient with wound for 2 months and 1 patient with wound for 3 months.

Hospitalization days

Hospitalization days	Number	Percentage (%)
Up to 7 days	18	36
8 to 30 days	35	70
31 to 90 days	7	14
Total	50	100

Table 3: Hospitalization days (N=50)

18 patients (36%) were hospitalized for 0-7 days. 70% patients (35 out 0f 50) were hospitalized for 8-30 days and 7 patients had a hospital stay of over 30 days, maximum being 90 days.

Average length of hospital stay was 16.9 days.

Peripheral pulses

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Peripheral pulses	Number	Percentage (%)
Absent	10	20
Present	40	80
Total	50	100

Table 4: peripheral pulses (N=50)

40 out of 50 patients (80%) had peripheral pulses at the time of presentation. 10 patients presented with absent peripheral pulsations.

Number of ulcers

Number of ulcers	Number	Percentage (%)
Single	29	58
Multiple	21	42
Total	50	100

Table 5: number of ulcers (N=50)

29 patients (58%) had a single diabetic ulcer and 21 patients (42%) had multiple diabetic foot ulcers.

Ulcer location

Ulcer location	Number	Percentage (%)
Foot	32	64
Toe	18	36
Total	50	100

Table 6: Location of ulcer (N=50)

18 patients (36%) had ulcers on the toes. Whereas, 32 patients (64%) had ulcers over the foot.

Probing to bone

Probing to bone	Number	Percentage (%)
No	37	74
Yes	13	26
Total	50	100

Table 7: probing to bone (N=50)

37 patients (74%) did not have bony involvement of the diabetic ulcer whereas, 13 patients (26%) had probing up to the bone.

Wound grading

Wound grading	Number	Percentage (%)
1	2	4
2	19	38
3	10	20

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4	9	18
5	10	20
Total	50	100

Table 8: Wound grading (N=50)

Wound grading was divided based on the depth of the wound. Garde 1- skin, grade 2- subcutaneous tissue, grade 3- fascia, grade 4- muscles, and grade 5- bone.

Only 2 patients had skin involvement. 38% (19 out of 50) had involvement of the subcutaneous plane, 20% (10 out of 50) had involvement of the fascia, 9 patients had muscle involvement and 10 patients (20%) had involvement of the underlying bone.

DUSS Score

DUSS Score	Number	Percentage (%)
0	7	14
1	18	36
2	17	34
3	7	14
4	1	2
Total	50	100

Table 9: DUSS scores (N=50)

DUSS scores were calculated based on the above parameters, minimum score of 0 and maximum of 4.

A DUSS score of 0 was present in 7 patients (14%). 18 patients (36%) had DUSS score of 1, 17 patients (34%) had a score of 2, 7 patients had score of 4 and only 1 patient had a score of 4.

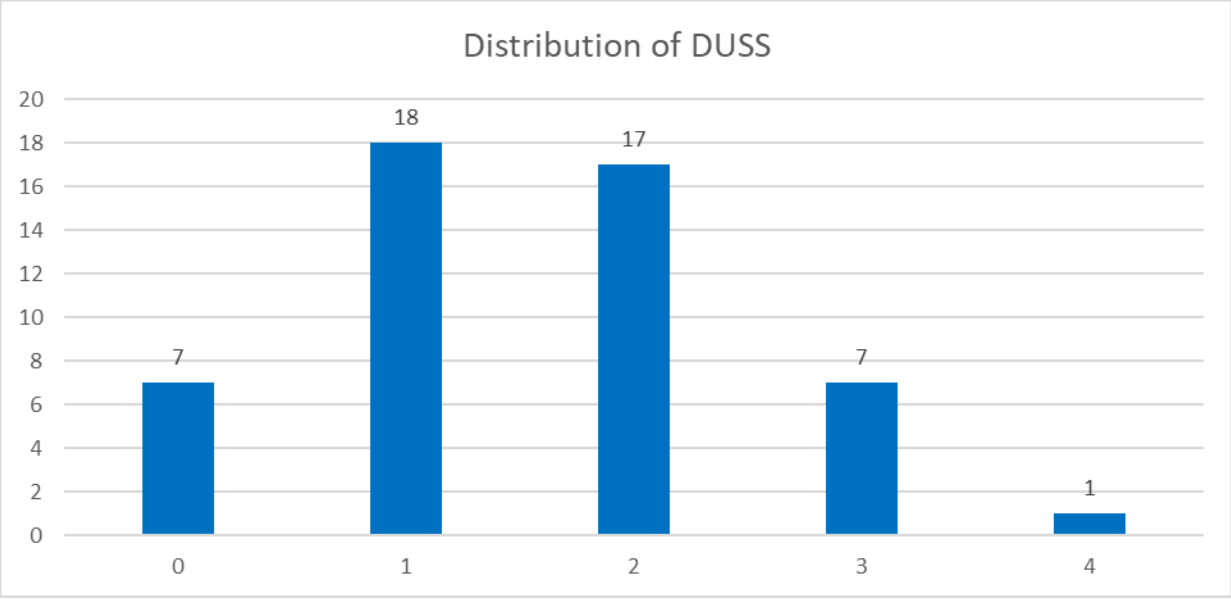

Figure 3: DUSS scores distribution

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Management

Management	Number	Percentage (%)
Surgical debridement	22	44
Skin grafting	4	8
Amputation	24	48
Total	50	100

Table 10: Management of patients with diabetic foot

Management of the patients was divided into debridement, amputations (major and minor) and skin grafting. 48% of the patients underwent an amputation. 22 patients (44%) underwent surgical debridement and 4 patients (8%) underwent skin grafting.

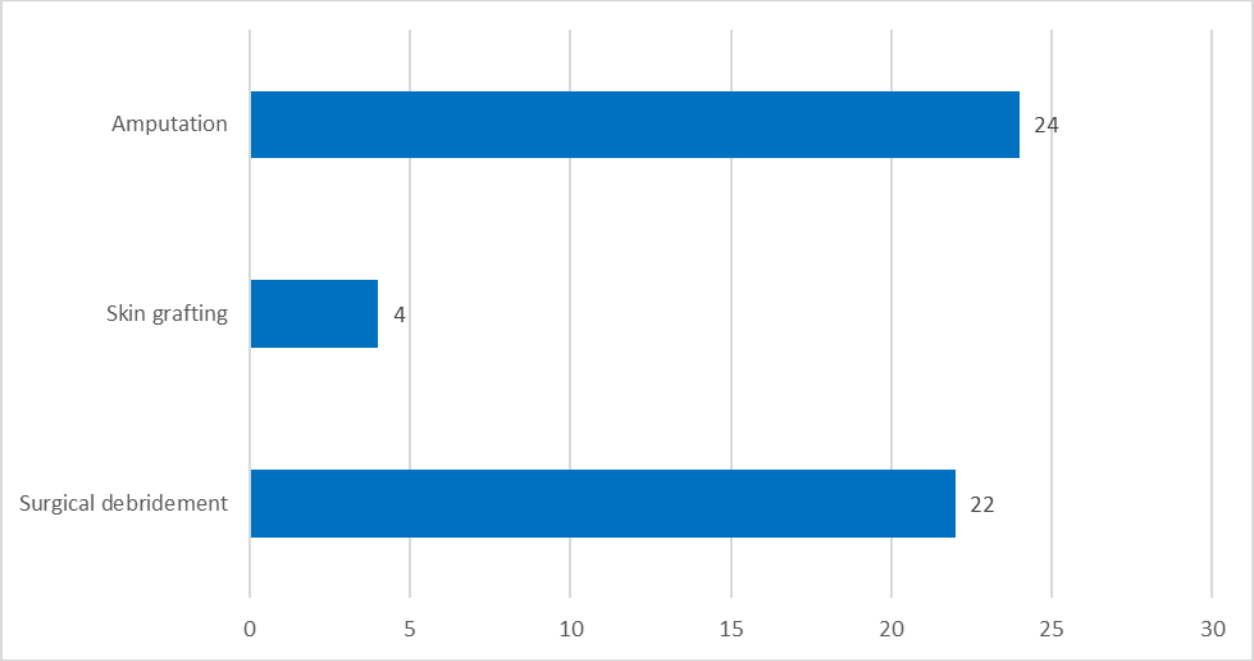

Figure 4: Management

Distribution of DUSS with management

DUSS Score	Surgical debridement	Skin grafting	Amputation	Total
0	3	0	4	7
1	11	2	5	18

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2	8	2	7	17
3	0	0	7	7
4	0	0	1	1
Total	**22**	**4**	**24**	**50**

Table 11:Distribution of DUSS with management

Out of 7 patients having a DUSS of 0, 3 (42.9%) underwent debridement and 4 (57.1%) underwent amputation. 18 patients with DUSS of 1, 11 (61.1%) patients had a debridement, 2 (11.1%) underwent skin grafting and 5 (27.8%) had amputations. 17 patients with DUSS of 2, 8 (47.1%) patients underwent debridement, 2 (11.8%) skin grafting and 7 (41.2%) amputations. All 7 patients with DUSS of 3 had an amputation and 1 patient with DUSS of 4 had an amputation.

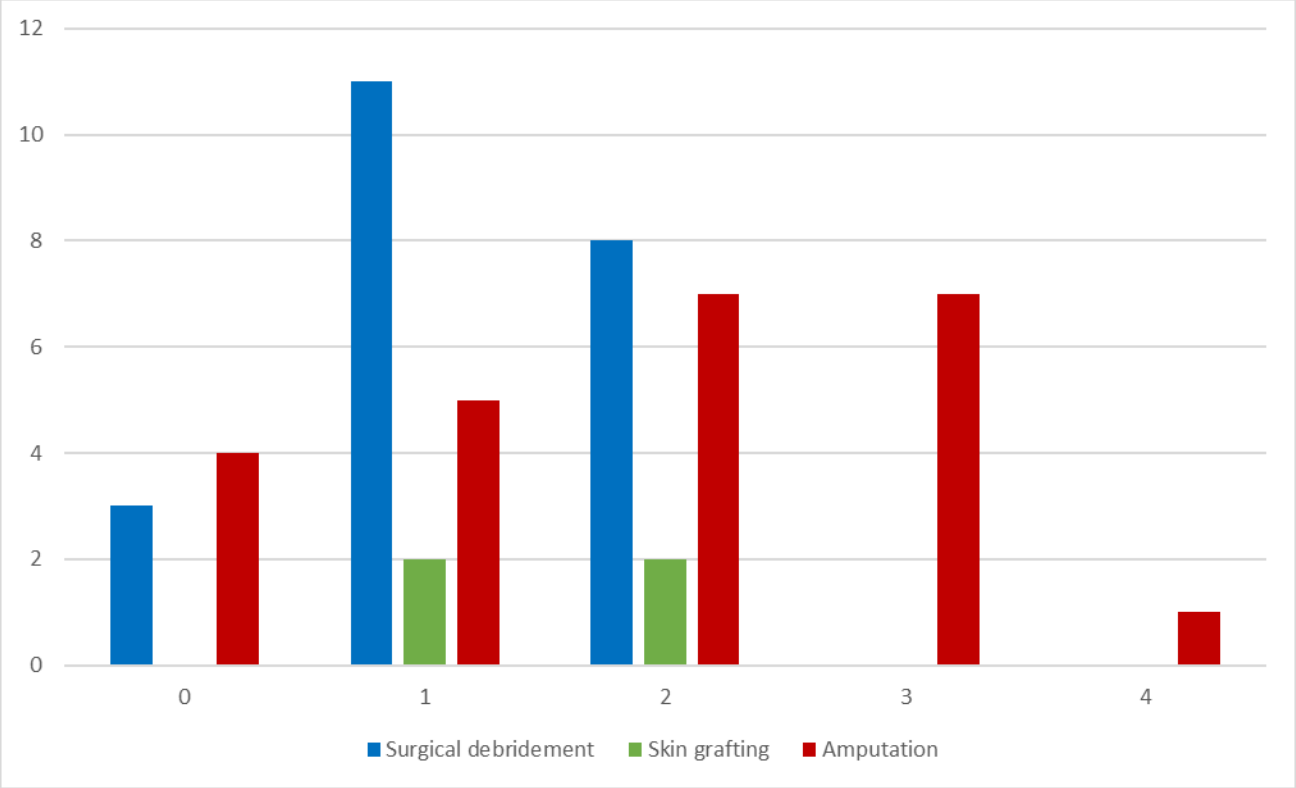

Figure 5: DUSS with management

Distribution of DUSS with a length of stay

DUSS Score	Length of stay	Total	χ^2-value (p-value)

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	Up to 7 days (%)	**8 – 30 days (%)**	**31 to 90 days (%)**		
0	7 (100)	0	0	7	33.22 (p-value = 0.00)
1	9 (50)	9 (50)	0	18	
2	2 (11.8)	12 (70.6)	3 (17.6)	17	
3	0	4 (57.1)	3 (42.9)	7	
4	0	0	1 (100)	1	
Total	**18**	**25**	**7**	**50**	

Table 12: Correlation of DUSS with length of hospital stay (N=50)

A comparison of DUSS with length of hospital stay was done, and a p-value of 0.00 was obtained using chi-square analysis. DUSS was found to be significantly correlating with the length of hospital stay, higher the DUSS, suggested longer period of hospitalization.

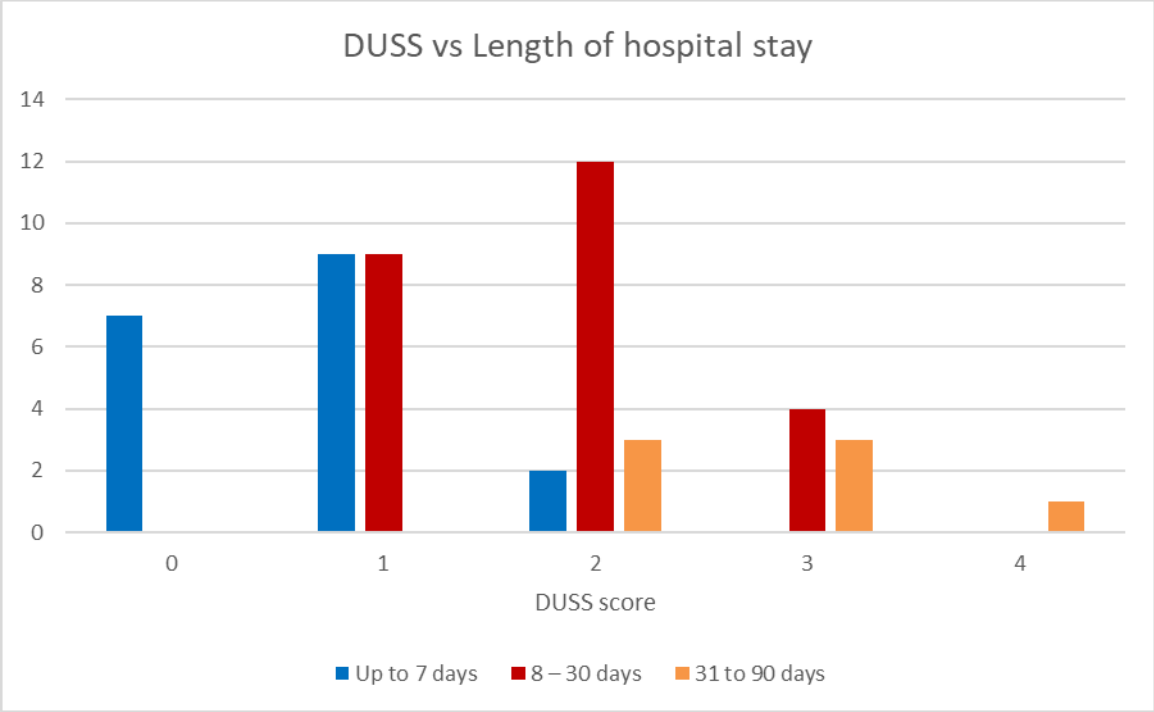

Figure 6: DUSS vs LOHS

Comparison of DUSS with amputation

DUSS Score	**Amputation**		**Total**	**χ^2-value (p-value)**
	No (%)	**Yes (%)**		
0	3 (42.9)	4 (57.1)	7	12.17 (p-value = 0.02)
1	13 (72.2)	5 (27.8)	18	

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2	10 (58.8)	7 (41.2)	17	
3	0	7 (100)	7	
4	0	1 (100)	1	
Total	**26**	**24**	**50**	

Table 13: Comparison of DUSS with amputation (N=50)

We obtained a significant correlation **(p-value-0.02)** while comparing DUSS with the numbers of amputations. It was found that increasing DUSS indicated amputations as the primary treatment modality and patients with lower scores were managed by debridement, amputation or skin grafting, and was found non-specific.

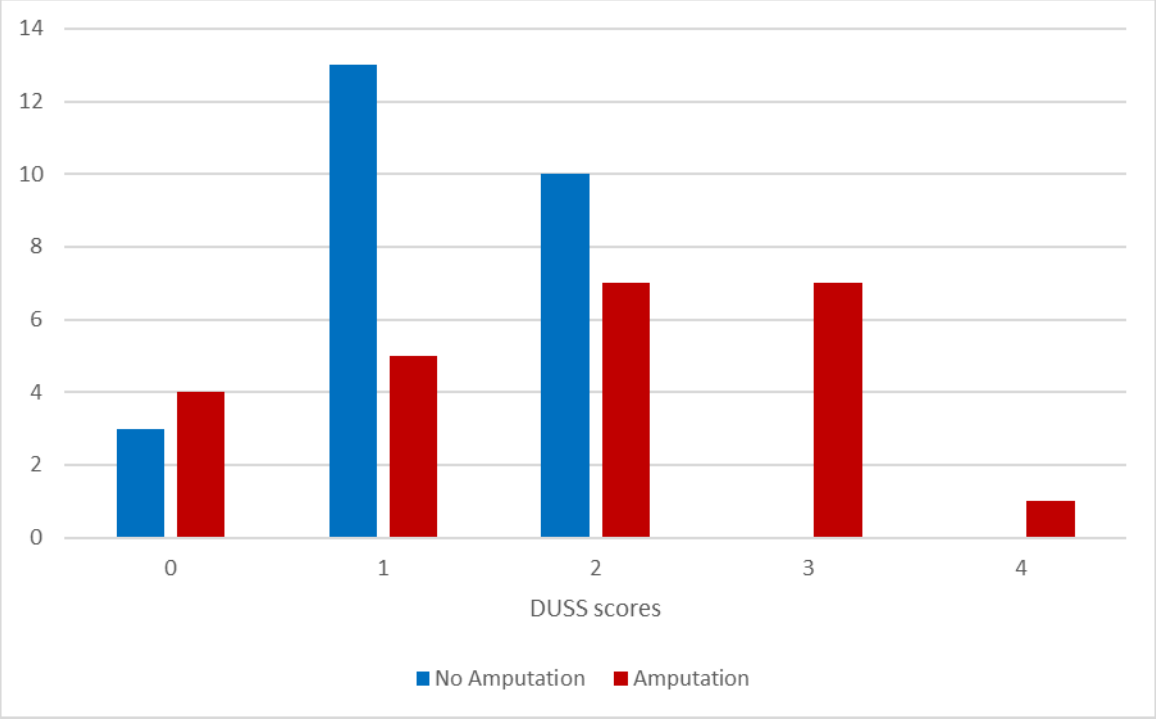

Figure 7: Comparison of DUSS with amputations

Subgroup analysis with respect to diabetic ulcer severity score

DUSS Score	Number	Wound duration*	Kruskal Wallis Test	Hospitalization days*	Kruskal Wallis Test
0	**7**	4 (2 – 8)	13.26 (0.01)	2 (2 – 4)	25.46 (0.00)
1	18	8 (4 – 90)		8.5 (1 – 24)	
2	17	10 (5 – 20)		17 (3 – 68)	
3	7	8 (4 – 60)		21 (13 – 100)	
4	1	30 (30 – 30)		37 (37 – 37)	

Table 14: Subgroup analysis with respect to DUSS

* **Median (Range)**

The median wound duration was the highest (30 (30 – 30)) among patients having DUSS 4, while it was

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the lowest (4 (2 – 8)) for patients with 0 DUSS. The Kruskal Wallis test statistics (13.26; p-value < 0.05) indicated the median wound duration differed significantly by DUSS score. The median hospitalization days increased with an increase in DUSS Score and the patients with a DUSS of 4 had the highest median hospitalization days (37 (37 – 37)). Similarly, median hospitalization days were statistically different with DUSS Score (Kruskal Wallis test statistics = 25.46; p-value < 0.05).

Discussion

The burden of diabetes mellitus is rapidly progressing in developed as well as developing countries like India, owing to sedentary lifestyle, higher genetic predisposition and obesity amongst several risk factors for diabetes mellitus.

Diabetic foot is one of the most common and unpreventable complication amongst diabetics and the prevalence of foot infection in diabetic patients in India is 26%-34% [5]

In our study amongst 50 patients presenting with a diabetic foot ulcer, we found a major predilection for males 38 (76%) and 12 (24%) were females. Study done by Beckert *et al* [4] in 2006 in 1000 patients found 675 (67.5%) males and 325 (32.5%) females. Saraswat *et al* [6] found similar results in 73 patients with 56 (76.71%) males and 17 (23.2%) females. Kumar ST *et al* [5] in 100 patients found 81 males and 19 females. These studies clearly a higher incidence of diabetic foots amongst men.

The most common age group affected in our study was 61-70 years (34%), second most common was 51-60 years (28%). On combining these age groups, we found 62% cases belonged to age groups of 51-70 years similar to Saraswat *et al* [6] Common age group affected was 51-60 in Kumar ST *et al* [5] while it was 41-60 years in Shashikala *et al* [7].

Median wound duration was 31 days in study by Beckert *et al* [4] and 60 days in Sharma *et al* [8] it was found to be 12 days in our study. Length of hospitalization varied significantly with majority patients (70%) being admitted for a period of 8-30 days. Minor amputations and simple debridement were discharged within 1-3 days.

DUSS scores were calculated for all patients and 70% patients had DUSS scores of 1 and 2. 24 patients underwent amputation as the primary line of management out of which 14 patients belonged to DUSS of 2 and 3. There was a significant correlation **(p-value- 0.02)** seen while comparing DUSS with number of amputations. With DUSS scores of 3 and 4, 100% patients underwent amputations whereas lower DUSS scores (0,1 and 2) patients were subjected to either amputations, debridement or skin grafting depending upon the presentation of the wound. Similar results were obtained in studies by Menezes JVF *et al* [9] Kumar ST *et al* [5] and Sharma *et al* [8]. 4 patients who underwent skin grafting had DUSS scores of 1 and 2.

Hence, a lower DUSS is not specific to any given line of management in our study, but higher score indicates an increased probability of amputation.

Surgical debridement was the second major treatment modality in 22 patients and 50% of these patients had a DUSS of 1. No patient with DUSS of 3 and 4 underwent debridement or skin grafting.

Hospitalization days were found to be increasing with increasing DUSS **(p-value- 0.00)** which signified higher rates of amputations requiring a prolonged hospital stay when compared to a surgical debridement or skin grafting.

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Figure 8: Right diabetic foot before and after debridement

Conclusion

Complications associated with diabetes mellitus are unpredictable and encompass a variety of diseases affecting the kidney, eyes, blood vessels etc. Diabetic foot remains a serious complication especially amongst Indian population due to occupations like farming, labor, and industrial work. Early onset of diabetic neuropathy, peripheral vascular disease and negligence of small wounds contribute to higher incidence of diabetic foot ulcers. Salvaging the limb is imperative for a disability free life.

Using the diabetic ulcer severity system for a diabetic foot is an easy clinical tool undertaking basic parameters of peripheral pulsation, number of ulcers, location of ulcer and bone involvement into consideration for predicting the prognosis. It helps to identify "at risk" patients during primary checkup and can help prevent drastic complications like gangrene, sepsis ultimately leading to amputations.

Higher DUSS scores were found to correlate with amputations and lead to a prolong hospital stay but lower DUSS scores had nonspecific management.

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Figure 9: Left 4th toe Ray amputation

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