International Surgery Journal
Ravoori HB et al. Int Surg J. 2023 Mar;10(3):443-449
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20230498

Original Research Article

A comparative study between Wagner's classification and new wound based diabetic foot ulcer severity score

Harish Babu Ravoori, Chinnala Hyndavi*, Pradeep Kumar Vunnam

Department of General Surgery, Mamata Medical College and Hospital, Khammam, Telangana, India

Received: 21 January 2023
Revised: 15 February 2023
Accepted: 18 February 2023

***Correspondence:**
Dr. Chinnala Hyndavi,
E-mail: hyndavi.chinnala@gmail.com

ABSTRACT

Background: Diabetes is considered to be one of the most common health problems all over the world in 21st century. In fact, it has been coined the 'Black death of the 21st century due to its stark similarities with the 14th century plague in terms of rapid increase in its prevalence, morbidity and mortality. According to WHO, the number of diabetic patients in 2000 reached to 171 million and was predicted to increase to 380 million by 2020. The Indian diabetic population is expected to increase to 57 million by the year 2025. Diabetic foot ulcers are one of the most distressing complications of diabetes affecting around 15% of people with diabetes. The annual incidence of diabetic foot ulcers is around 3% and the reported incidence in U.S and U.K studies ranges as high as 10%. It has been reported that 85% of the lower limb amputations in diabetic patients are preceded by foot ulceration. These systems are variously based on the site of ulcer, depth, and presence or absence of neuropathy, infection and peripheral arterial disease and have been used to compare the outcomes. Diabetic ulcer severity score (DUSS) is one of the latest wound-based systems of classification. However, there is paucity of enough data to validate whether DUSS system is better as compared to other established and commonly used scoring system like Wagner's classification. Hence, it was decided to validate DUSS scoring system with Wagner's classification by comparing both keeping in view outcome of the disease.
Methods: Patients admitted under various surgical units from January 2022-January 2023, at Mamata medical college and hospital, Khammam. Total of 40 diabetic patients with diabetic foot ulcers irrespective of their duration, attending surgical outpatient clinic or admitted into the hospital (Mamata general hospital) were recruited into the study based on the inclusion and exclusion criteria mentioned below.
Results: DUSS score and Wagner's score were found to be almost equal in evaluating the scores for treatment as p value was found to be statistically significant (p=0.001) and by KAPPA stats there was an absolute agreement (score 1) between DUSS and Wagner's scoring system.
Conclusions: The new severity scoring system (DUSS) is equal to gold standard Wagner's scoring system for predictive analysis which also provides an early idea regarding hospital admission, local surgery and health care costs. Since this scoring system 72 can be easily applied in daily clinical practice, it may be suitable in estimating putative healthcare costs.

Keywords: Diabetic ulcer severity score, Wagners classification, Diabetes

INTRODUCTION

Diabetes is considered to be one of the most common challenging health problems all over the world in the 21st century.[1] In fact, it has been coined the 'black death of the 21st century due to its stark similarities with the 14th Century Plague in terms of rapid increase in its prevalence, morbidity and mortality.[2]

According to WHO, number of diabetic patients in 2000 reached to 171 million and was predicted to increase to

380 million by 2020.[3] The Indian diabetic population is expected to increase to 57 million by year 2025.[4]

Diabetic foot ulcers are one of the most distressing complications of diabetes affecting around 15% of people with diabetes.[5] The annual incidence of diabetic foot ulcers is around 3% and the reported incidence in U.S and U.K studies ranges as high as 10%.[6] Diabetic foot ulcers pose a major public health problem worldwide and they are known to cause significant morbidity and mortality in diabetic patients.[7]

Over 50% of the ulcers become infected resulting in high rates of hospitalization, increased morbidities and potential lower extremities amputation.[8] It has been reported that 85% of the lower limb amputations in diabetic patients are preceded by foot ulceration.[9] People with diabetes with one lower limb amputation have a 50% risk of developing a serious ulcer in the second limb within 2 years.[10] People with diabetes have a 50% mortality rate in 5 years following initial amputation.[11]

A number of foot ulcer classification systems for example, the Wagner system, SAD classification and the university of Texas (UT) systems have been devised in an attempt to categorize ulcers more effectively and thereby, allow effective comparison of the outcome of routine management in different centers and treatment strategies. These systems are variously based on the site of ulcer, its depth, and presence or absence of neuropathy, infection and peripheral arterial disease and have been used to compare the outcomes.

Diabetic ulcer severity score (DUSS) is latest wound-based systems of classification. However, paucity of enough data to validate whether DUSS system is better as compared to other established and commonly used scoring system like Wagner's classification. Hence, it decided to validate DUSS scoring system with Wagner's classification by comparing both keeping in view outcome of disease process.

Aim and objectives

Aim and objectives were to compare Wagner's classification with new wound-based DUSS, to calculate Wagner's and DUSS and validation of the score with patient outcomes including healing and amputation

METHODS

The present study was conducted in the general surgery department, Mamata medical college and general hospital. All procedures involving experimental animals or human subjects must accompany a statement on ethical approval from appropriate ethics committee.

Place of study

Study conducted at department of general surgery, Mamata general hospital, Khammam.

Period of study

Study carried out from January 2022-January 2023.

Study sample size

The sample size was 40 study subjects.

Type of study

Type of study was comparative cross-sectional study.

Inclusion criteria

Patients in age group of 20-80 years irrespective of sex, all diabetic lower limb ulcers irrespective of their duration and patients willing to participate in the study were included.

Exclusion criteria

Venous stasis ulcers with diabetes mellitus, all patients with less than two follow up visits during observation period, non diabetic neuropathic ulcers, all non-diabetics with foot ulcers and patients unwilling for the study were excluded.

METHOD

Total of 40 diabetic patients with diabetic foot ulcers irrespective of their duration, attending surgical outpatient clinic or admitted into the hospital (Mamata general hospital) were recruited into the study based on the inclusion and exclusion criteria mentioned below. The baseline demographic data which included age, sex, occupation, education status, habits, socioeconomic status and treatment history were taken.

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 analysis. For wounds with identical grading, larger wound was chosen.

All the findings were entered in the respective proforma of individual patients. All patients were investigated for fasting and post prandial blood sugars, culture sensitivity swabs were sent from the wounds, x rays of foot were taken followed by routine workup investigations were done as mentioned in proforma.

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.

DUSS

Ulcers were scored by the below mentioned variables. DUSS was calculated by adding these separate scored variables to a theoretical maximum of 4

Wagner's classification

Ulcers were scored by the below mentioned variables. Wagner's score was calculated by adding these separate scored variables to a theoretical maximum of 5.

Standard treatment care was given to all these patients, which included oral hypoglycaemic or insulin for good control of diabetes, health education, antibiotics and regular wound care.

Healing was defined as complete epithelization 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/ above-knee amputation were taken as major amputation.

Follow up

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

Statistical analysis

A descriptive statistic based on the comparative study of "DUSS" and "Wagner's" considering cases was analysed and expressed in percentages. Baseline characteristics were expressed as mean, median and inter quartile range.

Chi square used as test of significance categorical data.

Kappa statistics method was used to assess the level of agreement between two scoring methods to find the correlation between DUSS and Wagner's.

RESULTS

Age distribution

Most common age group affected with diabetic foot was between 51-60 years (50%), followed by the age group of 61-70 years (35%). Mean age group was 60.950±8.6022 years. Median age was 60.0 (IQR 55.25 to 68 years).

Sex distribution

In this study males (75%) were found to be affected more from diabetic foot ulcer as compared to their female counterparts (25%) in a ratio of 3:1.

Patient distribution as per Wagner's classification

It was seen that max no of patients 16(40%) had score of 2, 12 cases (30%) of score 2, followed by 8 patients (20%) had score 4 and 4 patients (10%) with score 5.

Patient distribution as per DUSS score

It is seen that max number of cases 26 (65%) are with DUSS score 2 followed by 9 patients (22.5%) are with score 3 and 5 cases (12.5%) with score 4 (Table 1).

Table 1: Patient distribution as per DUSS score, (n=40).

DUSS score	N	Percentage (%)
0	0	0
1	0	0
2	26	65
3	9	22.5
4	5	12.5
Total	40	

Patient distribution as per treatment

It was seen that 5 cases (12.5%) underwent major amputation BKA, 5 cases (12.5%) underwent debridement followed by split skin grafting, 20 cases (50%) underwent debridement followed by regular dressings and 10 cases (25%) had undergone minor ray amputation.

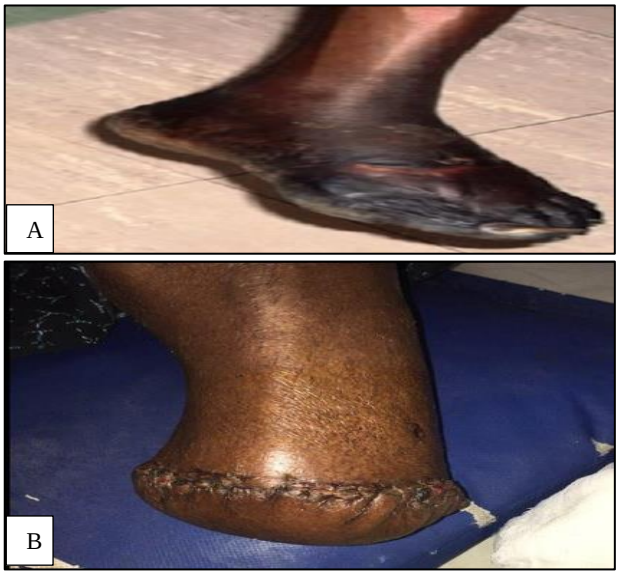

Figure 1 (A and B): Gangrenous diabetic left foot and stump after below-knee amputation.

Figure 2 (A and B): Diabetic ulcer left foot and after split skin grafting.

Treatment * DUSS score base line (BL)

Here DUSS score base line was compared with different treatment strategies which had shown chi square value of 65.641 and p=0.001 which was found to be significant. The findings are depicted in following Table 2.

Table 2: DUSS score base line with varied treatment strategies.

Treatment		DUSS score BL			Total
		2	3	4	
BKA	Count	0	0	5	5
	%	0	0	100	100
D SSG	Count	4	1	0	5
	%	80	20	0	100
DD	Count	20	0	0	20
	%	100	0	0	100
RA	Count	2	8	0	10
	%	20	80	0	100
Total	Count	26	9	5	40
	%	65	22.5	12.5	100

Treatment * Wagner's score base line (BL)

Here Wagner's score base line was compared with different treatment strategies which had shown chi square value of 58.708 and p=0.001 which was found to be significant. The findings are depicted in following Table 3.

Table 3: Wagner's score base line with varied treatment strategies.

Treatment		Wagner score BL				Total
		2	3	4	5	
BKA	Count	0	0	1	4	5
	%	0	0	20	80	100
D SSG	Count	1	4	0	0	5
	%	20	80	0	0	100
DD	Count	11	9	0	0	20
	%	55	45	0	0	100
RA	Count	0	3	7	0	10
	%	0	30	70	0	100
Total	Count	12	16	8	4	40
	%	30	40	20	10	100

Treatment * DUSS score 1 (first follow-up)

Here DUSS score 1st follow up compared with different treatment strategies which had shown chi square value of 40 and p=0.001 which found to be significant (Table 4).

Table 4: DUSS score first follow up with varied treatment strategies.

Treatment		DUSS score 1		Total
		0	1	
BKA	Count	5	0	5
	%	100	0	100
D SSG	Count	5	0	5
	%	100	0	100
DD	Count	0	20	20
	%	0	100	100
RA	Count	10	0	10
	%	100	0	100
Total	Count	20	20	40
	%	50	50	100

Treatment * Wagner score 1 (first follow up)

Wagner's score 1st follows up compared with different treatment strategies which had shown chi square=40, p=0.001 which found to be significant (Table 5).

Table 5: Wagner's score first follow up with varied treatment strategies.

Treatment		Wagner score 1			Total
		0	1	2	
BKA	Count	5	0	0	5
	%	100	0	0	100
D SSG	Count	5	0	0	5
	%	100	0	0	100
DD	Count	0	11	9	20
	%	0	55	45	100
RA	Count	10	0	0	10
	%	100	0	0	100
Total	Count	20	11	9	40
	%	50	27.5	22.5	100

Treatment * DUSS score 4 (fourth follow up)

Here DUSS score fourth follow up was compared with different treatment strategies which had shown chi square value of 1.026 and p=0.795 which was found to be insignificant. The findings are depicted in following Table 6.

Table 6: DUSS score fourth follow up with varied treatment strategies.

Treatment		DUSS score 4		Total
		0	1	
BKA	Count	5	0	5
	%	100	0	100
D SSG	Count	5	0	5
	%	100	0	100
DD	Count	19	1	20
	%	95	5	100
RA	Count	10	0	10
	%	100	0	100
Total	Count	39	1	40
	%	97.5	2.5	100

Treatment * Wagner score 4 (fourth follow up)

Here Wagner's score fourth follow up was compared with different treatment strategies which had shown chi square value of 1.026 and p=0.795 which was found to be insignificant. The findings are depicted in following Table 7.

Table 7: Wagner's score fourth follow up with varied treatment strategies.

Treatment		Wagner score 4		Total
		0	1	
BKA	Count	5	0	5
	%	100	0	100
D SSG	Count	5	0	5
	%	100	0	100
DD	Count	19	1	20
	%	95	5	100
RA	Count	10	0	10
	%	100	0	100
Total	Count	39	1	40
	%	97.5	2.5	100

Kappa stats

DUSS score 1 vs Wagner's score 1 (first follow up)

Here using kappa stats when DUSS score first follow was compared with Wagner's score first follow up, kappa value was found to be 0.633 and p value of 0.001 which was found to be significant. It is depicted in the following Table 8.

Table 8: DUSS score first follow up vs Wagner's score first follow up.

DUSS score 1	Wagner's score 1			Total
	0	1	2	
0	20	0	0	20
1	0	11	9	20
Total	20	11	9	40
			P value	
Measure of agreement	Kappa		0.633	0.001

DUSS score 4 vs Wagner's score 4 (fourth follow up)

Here using kappa stats when DUSS score third follow is compared with Wagner's score third follow up, kappa value was found to be 1.000 and p value of 0.001 which was found to be significant. It is depicted in the following Table 9.

Table 9: DUSS score fourth follow up vs Wagner's score fourth follow up.

DUSS score 4	Wagner's score 4		Total
	0	1	
0	39	0	39
1	0	1	1
Total	39	1	40
		P value	
Measure of agreement	Kappa	1.000	0.001

DISCUSSION

Diabetes mellitus (DM) is a group of metabolic disorders characterized by hyperglycaemia, which may be caused by impaired insulin secretion, insulin dysfunction or both. The main subtypes of diabetes are type 1 DM (T1DM) and type 2 DM (T2DM) that affect almost 200 million people all around the world[12].

Diabetic foot ulcers are the most common and much feared complication of diabetes, with recent studies suggesting that the lifetime risk of developing a foot ulcer in diabetic patients may be as high as 25%.[13]

Foot ulceration requires long and intensive treatment has important effects on quality of life of both patients and caregivers and is associated with major healthcare costs.[14]

The morbidity and mortality associated with diabetic foot lesions remain extremely high, and management needs to be optimized to ensure the best outcome.[15]

In Indian population, prevalence of diabetic foot is 5.3 to 10.5%, where the incidence of below knee amputation and toe amputation is 1.6% and 2.6% respectively. Hence, diabetic foot ulcer is one of the greatest health burdens in India considering its morbidity.

Total of 40 diabetic patients with foot ulcers irrespective of duration of ulcers attending surgical outpatient clinic or admitted in Mamata general hospital were recruited into this study based on the inclusion and exclusion criteria mentioned[16] earlier. All these patients were classified under both Wagner's and DUSS classification for diabetic foot ulcer. The results and outcome in both the classification systems were compared. The results were further compared with the available literature.

In present study according to Wagner's scoring system maximum number of cases were seen in grade 3 (40%) followed by 2 (30%) and 4 (20%) as compared with other studies as mentioned in Table 10.

Table 10: Comparison of different studies on Wagner's with present study.

Wagner's score	No. of patients, n (%)			
	Gupta et al[17]	Rajyalakshmi et al[18]	Akhter et al[19]	Present study
Grade 0	0 (0)	0 (0)	0 (0)	0 (0)
Grade 1	18 (18)	15 (15)	9	0 (0)
Grade 2	22 (22)	38 (38)	19	12 (30)
Grade 3	16 (16)	29 (29)	13	16 (40)
Grade 4	34 (34)	13 (13)	11	8 (20)
Grade 5	10 (10)	5 (5)	3	4 (10)

In the present study, treatment strategy is divided into 4 groups: 1. Debridement followed by regular dressings, 2. Debridement followed by split skin grafting, 3. Minor amputations (Ray amputation) and 4. Major amputations (AKA / BKA).

Follow up

First follow up (after 15 days)

Using chi square and considering DUSS score first follow up visit, 5 cases (100%) who underwent BKA their DUSS score was 0, 10 cases (100%) who underwent ray amputations their DUSS score was 0, 5 cases (100%) who underwent debridement followed by split skin grafting their DUSS score was 0, 20 cases (100%) who underwent debridement followed by regular dressings their DUSS score was 1 in first follow up visit with chi square=40 and p=0.001 which is statically significant.

Using chi square and considering Wagner's score first follow up visit, 5 cases (100%) who underwent BKA their score was 0, 10 cases (100%) who underwent ray amputations their score was 0, 5 cases (100%) who underwent debridement followed by split skin grafting their score was 0, 11 cases (55%) with score 1 and 9 cases (45%) with score 2 who underwent debridement followed by regular dressings in first follow up visit with chi square=40 and p=0.001 which is statically significant.

Fourth follow up (after 90 days)

Using chi square and considering DUSS score fourth follow up visit, 5 cases (100%) who underwent BKA their DUSS score was 0, 10 cases (100%) who underwent ray amputations their DUSS score was 0, 5 cases (100%) who underwent debridement followed by split skin grafting their DUSS score was 0, 19 cases (95%) with score 0 and 1 case (5%) with score 1 in fourth follow up visit with chi square value of 1.026 and p=0.795 which is statically insignificant.

Using chi square and considering Wagner's score fourth follow up visit,5 cases (100%) who underwent BKA their score was 0,10 cases (100%) who underwent ray amputations their score was 0, 5 cases (100%) who underwent debridement followed by split skin grafting their score was 0, 19 cases (95%) with score 0 and 1 case (5%) with score 1 in fourth follow up visit with chi square value of 1.026 and p value of 0.795 which is statically insignificant.

The limitations of our study is the small sample size and short follow up.

CONCLUSION

DUSS and Wagner's scoring system provide an easy diagnostic tool for predicting probability of healing or amputation by combining four to five 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 the wound management.

This new severity scoring system (DUSS) is equal to gold standard Wagner's scoring system for predictive analysis which also provides an early idea regarding hospital admission, local surgery and health care costs. Since this scoring system can be easily applied in daily clinical practice, it may be suitable in estimating putative healthcare costs. The proposed score classification (DUSS) system for the diabetic foot may enable better quality of life for diabetic patients and promote better low-cost care for millions of individuals worldwide.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. McInnes AD. Diabetic foot disease in the United Kingdom: about time to put feet first. J Foot Ankle Res. 2012;5(1):1.
2. Lazzarini PA, Gurr JM, Rogers JR, Schox A, Bergin SM. Diabetes foot disease: the Cinderella of Australian diabetes management? J Foot Ankle Res. 2012;5(1):1.
3. Aalaa M, Malazy OT, Sanjari M, Peimani M, Mohajeri-Tehrani MR. Nurses' role in diabetic foot prevention and care; a review. J Diabetes Metabol Disord. 2012;11(1):1.
4. Shanmugam P, Jeya M, Linda SS. The bacteriology of diabetic foot ulcers, with a special reference to multidrug resistant strains. J Clin Diagn Res. 2013;7(3):441-5.
5. Singh S, Pai DR, Yuhhui C. Diabetic Foot Ulcer? Diagnosis and Management. Clin Res Foot Ankle. 2013;2013.
6. Clayton W, Elasy TA. A review of the pathophysiology, classification, and treatment of foot ulcers in diabetic patients. Clin Diabetes. 2009;27(2):52-8.
7. Chalya PL, Mabula JB, Dass RM, Kabangila R, Jaka H, Mchembe MD et al. Surgical management of Diabetic foot ulcers: A Tanzanian university teaching hospital experience. BMC Res Notes. 2011;4(1):1.
8. Hobizal KB, Wukich DK. Diabetic foot infections: current concept review. Diabetic Foot Ankle. 2012;8:3.
9. Deribe B, Woldemichael K, Nemera G. Prevalence and factors influencing diabetic foot ulcer among diabetic patients attending Arbaminch Hospital, South Ethiopia. J Diabetes Metabol. 2014;2014.
10. Jude E. Assessment of the diabetic foot. Chronic Wound Care: Chapter 58. Krasner, DL. A Clinical Sourcebook for Healthcare Professionals, Third Edition, HMP Communications Inc. 2001;589-97.
11. Armstrong DG, Lipsky BA. Diabetic foot infections: stepwise medical and surgical management. Int Wound J. 2004;1(2):123-32.
12. McKeown KC. History of the diabetic foot. Foot. 1992;2(3):179-82.
13. JOSLIN EP. The menace of diabetic gangrene. N Eng J Med. 1934;211(1):16-20.
14. Ward JD. The cost of diabetic foot problems. Pharmacoeconomics. 1995;8(1):55-7.
15. Foster A, Coles PC. Psychological aspects of treating the diabetic foot. Pract Diab Int. 1997;14(2):56-8.
16. Wagner FW. The dysvascular foot: a system for diagnosis and treatment. Foot Ankle Int. 1981;2(2):64-122.
17. Gupta A, Haq M, SinghM. Management Option in Diabetic Foot According to Wagner's Classification: An Observational Study. JK Sci J Med Educ Res. 2016;18(1).
18. Rajyalakshmi Y, Amruthavalli BV. Evaluation and Management of Diabetic Foot According to Wagner's Classification. J Dental Med Sci. 2017;16(12):25-33.
19. Akhter JM, Khan IA, Shahpurkar VV, Khanam N, Syed ZQ. Evaluation of the diabetic foot according to Wagner's classification in a rural teaching hospital. Br J Diabetes Vasc Dis. 2011;11:74-79.
20. Rathur HM, Boulton AJ. Pathogenesis of foot ulcers and the need for offloading. Hormone Metabol Res. 2005;37(S 1):61-8.
21. Kummankandath SA. Validation of diabetic ulcer severity score. Int Surg J. 2016;3(3):1509-16.

Cite this article as: Ravoori HB, Hyndavi C, Vunnam PK. A comparative study between Wagner's classification and new wound based diabetic foot ulcer severity score. Int Surg J 2023;10:443-9.