

# Diabetic Foot Classification (Wagner Classification System) as A Predictor of Outcome: Study of 50 Patients

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## ABSTRACT

**Objective:** To predict the outcome of diabetic foot wound using Wagner classification system.

**Design:** Descriptive Study

**Setting:** Surgical Unit 1, Department of Surgery, Jinnah Hospital Lahore

**Duration of Study:** One year (January 2010 to December 2010)

**Subject & Method:** Fifty cases were included in this study. In all the patients wounds were graded using Wagner classification system, Ulcer was labeled infected if a purulent discharge was present along with the other local signs (warmth, erythema, pain, oedema and lymphadenopathy).

### Main Outcome Measures:

- Grades according to Wagner classification system
- Condition of ulcers
- Amputation done.

**Results:** Out of these 50 patients 30 (60%) were males and 20 (40%) were females (Table-1). The mean age of male patients was  $54.33 \pm 8.04$  and female patients  $56.40 \pm 6.52$ .

Out of total 50 patients, 24 patients (48%) were graded as Grade-I according to Wagner classification system. 13 patients (26%) were labeled as Grade-II, 9 patients (18%) had a presentation of Grade III of classification system and 4 patients (8%) were put in category of Grade-IV whereas there was no presentation in Grade-V and Grade-0 at all.

At the end of one year time, out of 24 patients (48%) who were labeled as Grade-I, only one patient underwent amputation and percentage number amputation was (4.2%), and among the remaining 23 patients percentage number of healed ulcers was 87% against the percentage number of unhealed ulcers as 13%.

Similarly, in the 13 patients (26%) with diabetic foot ulcer of Grade-II variety, the percentage number of amputation was 15.4% (2 patients) whereas in remaining 11 patients (22%) percentage number of healed ulcers was (45.5%) against percentage number of unhealed ulcers which was (54.5%).

Likewise out of the 9 patients (18%) which were put in Grade-III 8 patients underwent some kind of amputation and the percentage number of amputation was found to be (88.9%), while the remaining 1 patient in this group showed complete healing with a percentage number of healed ulcer as 100% interestingly.

All patients who were labeled as Grade-IV i.e. 4 (8%) underwent some form of amputation with percentage number amputation as 100%.

**Conclusion:** The results of this study indicate that outcomes deteriorate with increasing grade of Wangner classification system. As in this study, we have shown a trend towards an increased prevalence of amputation with advancing depth and presence of infection.

**Key Words:** Wagner classification system, Diabetic foot, Amputation.

## INTRODUCTION

Diabetic mellitus is a universal disease, which reaches its peak incidence in the 5<sup>th</sup> decade. Diabetes mellitus as well as its complications are as old as human civilization. The term diabetes was introduced by "Cappadocia" and means "to Siphon" or pass through. And the word "mellitus" is derived from the Latin word used for honey. It was

in AD 1000 when "Avicenna" demonstrated many complications of diabetes mellitus including pyodermic infections, diabetic gangrene and sweetness found in the urine [1]. Lundback in 1954 introduced the concept of microangiopathy as the common mechanism leading to diabetic complications like retinopathy, nephropathy, cardiovascular disease and diabetic foot a surgical

problem. A drastic change occurred when Banting and Best isolated insulin from pancreas with miraculous effect for the control of diabetes mellitus [2].

The presentation of diabetes mellitus can be extremely polymorphic and while in earlier time the involvement of foot was considered rare, the majority of modern authors recognize its real frequency and gravity. It is considered that 1 in 7 diabetics suffer from diabetic foot disease (3). World wide 10-25% of all diabetics develop some form of foot problems during their course of illness ranging from simple calluses to major abscesses.

The US national commission estimates that 5-15% of all diabetics will require amputation at some time in their lives [3, 4]. Amputations have not only been associated with increased risk of re-amputation [4] of same limb but the contra lateral leg also [5]. The 5 years survival rate is only 30% after amputation [6]. The most common well accepted components in the casual pathway of limb loss include neuropathy, ulceration, infection and ischemia. Ulceration is the most common single precursor to amputation and has been identified in 85% cases of lower extremity amputation, usually as a consequence of non healing ulcer as shown by a previous study [6,7,8] and its is particularly true for heel ulcers [8,9].

Confounding factors like ulcer depth, infection and ischemia are critical to planning treatments strategies, monitoring treatment effectiveness, predicting outcome and improving communications among health care providers.

Shea, in 1975 was one of the first to propose a standard wound classification system. One of the most commonly cited diabetic wound classification was described by Meggit in 1976 and popularized by Wagner in 1981 [9, 10].

The Wagner system assesses ulcer depth, osteomyelites and gangrene by using following 6 grades G0 (intact skin) G1 (superficial ulcer) GII (deep ulcer) GIII (deep ulcer with abscess and osteomyelites) GIV (fore foot gangrene) GV (whole foot gangrene.)[11]

## AIM AND OBJECTIVE

The objective of the study was to. To predict the outcome of diabetic foot wound using Wagner classification system.

## MATERIALS AND METHODS

This study was conducted at surgical unit I, Jinnah Hospital Lahore.

## Period of Study

This study was conducted over a period of one year. (January 2010 to December 2010)

## Sample Size

All the patients coming to OPD and emergency of the hospital, 50 patients were included in this study.

## Sampling Technique

Purposive sampling.

## Study Design

Descriptive Study

## Inclusion Criteria

Diagnosed patients of type II diabetes mellitus of either sex having diabetic foot wounds and who were above 40 years of age.

## Exclusion Criteria

Patients with other systemic co-morbidities like hepatic failure, renal failure, congestive cardiac failure and primary peripheral vascular disease were not included in this study.

## Data Collection

Data was collected by filling the study proforma according to inclusion criteria.

## Data Analysis

Computer software SPSS ver. 10.0 was used for statistical analysis of data. Data will be processed to find out proportion of patients with diabetic foot ulcers falling in above given grades and stages according to Wagner classification system and to find out proportion of outcome of different grades. Results are presented as proportions and percentages in the form of the tables and graphs.

## Wagner grading system is as follows: [9, 10, and 11]

**Grade 0:** There is no open lesion, but potential break down with high pressure deformity and sensory neuropathy

**Grade 1:** The lesion is superficial through the skin only with or without underlying bony prominence.

**Grade 2:** The ulcer is deep penetrating to tendon, joint or bone.

**Grade 3:** There is deep abscess formation within plantar space and tendon sheath infection, osteomyelitis or septic arthritis.

**Grade 4:** Gangrene is present locally in toes or more diffuse over the forefoot.

**Grade 5:** Gangrene has spread and involves the hind foot requiring a higher amputation.

**MEHTODOLOGY**

In all the patients fulfilling the inclusion criteria, wound was graded using Wagner classification system. Ulcer was labeled infected if a purulent discharge is present along with two other local signs like (warmth, erythema, pain, oedema and lymphadenopathy). Wound depth was evaluated using a sterile blunt probe. The radiological features provide diagnosis of osteomyelitis. The diagnosis of lower extremity vascular insufficiency was made clinically on the basis of absence of one of the pulses of effected side. The presence of significant sensory neuropathy was assessed by using tuning fork. Each patient was classified according to Wagner classification system at first presentation and then was admitted in the ward after culture and sensitivity. He was put on specific antibiotics and was treated according to recommended treatment of each grade and subsequently was followed up in the OPD after every two weeks. Non healing ulcers were managed conservatively for a minimum period of three months. Either the patient’s ulcer healed or amputation was done. The outcome was noted.

**RESULTS**

A total of 50 patients with Diabetic foot who fulfilled the inclusion criteria underwent continued follow up in the OPD for one year. Out of these 50 patients 30 (60%) were males and 20 (40%) were females (Table-1). The mean age of male patients was 54.33±8.04 and female patients 56.40±6.52.

**Table 1:** Sex distribution of subjects

Sex	Number	Percentage
Male	30	60.0
Female	20	40.0
Total	50	100.0

Amongst study population 11 patients (22%) were less than 50 years of age, 27 patients (54%) were between 50-59 years of age, this was the largest presentation group.9 patients (18%) were between the age group 60-69 and only 3 patients (6%) were found in age group of 70 and above (Table2).

**Table 2:** Age distribution of subjects

Age (Yrs)	Number	Percentage
<50	11	22.0
50-59	27	54.0
60-69	09	18.0
≥70	03	06.0
Total	50	100.0
Mena ±SD	55.16±7.47	

Ten patients (20%) had a history of diabetes mellitus for 10- or more than 10 years, whereas 40 patients (80%) had a history of diabetes mellitus for less than 10 years (Table-3).

**Table 3:** Duration of Diabetes

Duration (yrs)	Number	Percentage
<10	40	34.0
≥10	10	66.0
Total	100	100.0

In 30 patients (60%) evidence of neuropathy was found while other 20 patients (40%) were found free of any kind of neuropathy (Table-4).

**Table 4:** Evidence of Neuropathy

	Number	Percentage
Yes	30	60.0
No	20	40.0
Total	50	100.0

Evidence of ostemyellitis was detected in 11 patients (22%) whereas 39 patients (78%) were found negative for any sign of bone involvement (Table-5).

**Table 5:** Evidence of Osteomyelitis

	Number	Percentage
Yes	11	22.0
No	39	78.0
Total	50	100.0

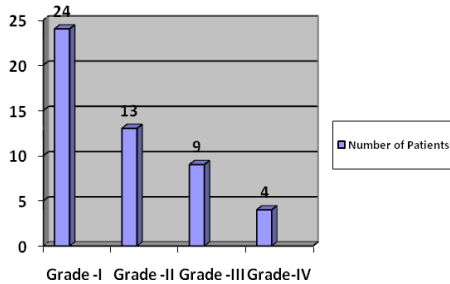
Out of total 50 patients, 24 patients (48%) were graded as Grade-I according to Wagner classification system. 13 patients (26%) were labeled as Grade-II 9 patients (18%) had a presentation of Grade-III of classification system

and 4 patients (8%) were put in category of Grade-IV where as there was no presentation in Grade-V and Grade-0 at all (Table-6, Fig.1).

**Table 6:** Distribution of subjects according to Wagner classification system

Grade	Number	Percentage
Grade-I	24	48.0
Grade-II	13	26.0
Grade-III	09	18.0
Grade-IV	04	08.0
Total	50	100.0

**Fig 1:** Distribution of subjects according to Wagner classifications system

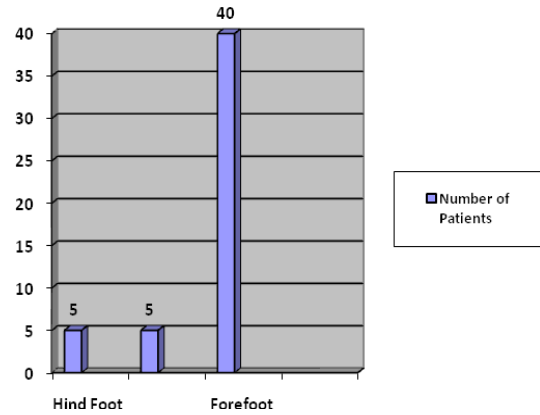


Majority of studied population that is 40 patients (80%) had the ulcer in the forefoot area, 5 patients (10%) were presented with wounds at heel and adjoining area i.e. (hind foot) and 5 (10%) with their wounds at mid foot level. (Table-7, Fig.2).

**Table 7:** Site of Injury

Site of Injury	Number	Percentage
Hind Foot	05	10.0
Mid Foot	05	10.0
Forefoot	40	80.0
Total	50	100.0

**Fig 2:** Site of Injury



At the termination of observation period i.e. at the end of 3 months time, out of 24 patients (48%) who were labeled as Grade-I, only one patient underwent amputation and percentage number amputation was (4.2%), and among the remaining 23 patients percentage number of healed ulcers was 87% against the percentage number of unhealed ulcers as 13%.

Similarly, in the 13 patients (26%) with diabetic foot ulcer of Grade-II variety, the percentage number of amputation was 15.4% , whereas in remaining 11 patients (22%) percentage number of healed ulcers was (45.5%), against percentage number of unhealed ulcers which was (54.5%).

Likewise out of the 9 patients (18%) which were put in Grade-III 8 patients underwent amputation and the percentage number of amputation was found to be (88.9%) , while the remaining 1 patient in this group showed complete healing with a percentage number of healed ulcer as 100%.

All patients who were labeled as Grade-IV i.e. 4 (8%) underwent amputation with percentage number amputation as 100% (Table-8, 9, Fig3&4).

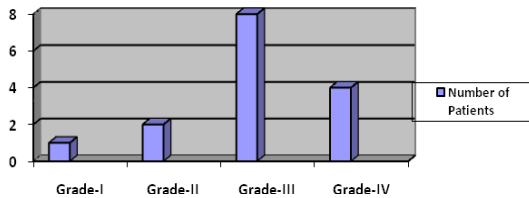
**Table 8:** Amputation

Amputation	Grade-I	Grade-II	Grade-III	Grade-IV	Total
Yes	1 (4.2%)	2 (15.4%)	8 (88.9%)	4 (100%)	15 (30.0%)
No	23 (95.8%)	11 (84.6%)	1 (11.1%)	0	35 (70.0%)
Total	24 (100%)	13 (100%)	09 (100%)	04 (100%)	50 (100%)

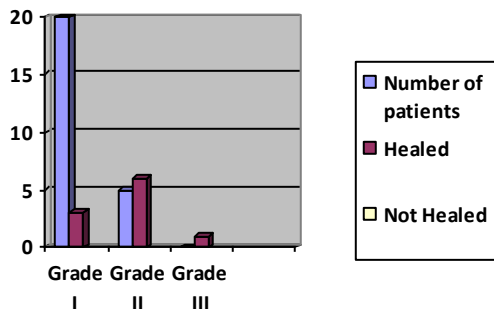
**Table 9:** Ulcer condition at termination of observation period

Condition of ulcer	Grade-I	Grade-II	Grade-III	Total
Healed	20 (87.0%)	05 (45.5%)	-	25 (71.4%)
Not Healed	03 (13.0%)	06 (54.5%)	1 (100.0%)	10 (28.6%)
Total	23 (100.0%)	11 (100.0%)	01 (100.0%)	35 (100.0%)

**Fig 3:** Amputations



**Fig 4:** Ulcer condition



**DISCUSSION**

Foot ulcers occur in 5-10% of diabetic patients, and a third of these may lead to lower limb amputation of some kind. The likelihood of amputation increases with ulcer depth and the presence of infection. So, while treating these ulcers empirically, which ends up with serious outcomes like prolonged morbidity and amputation, we must have certain systematic parameter to evaluate this serious problem. For that matter many different classification systems have been reported in the literature, but the classification system developed by Wagner for grading of diabetic foot ulcers has been widely used and accepted for many years [12,13]. It is easy to use and helps in planning treatment strategies and predicting clinical outcome (particularly in our clinical setting). This study is also based upon the same "Wagner classification system" in predicting

outcome and for directing appropriate therapy according to the presenter lion grade. [14]

Multiple studies have been carried out on this problem earlier in different parts of the world with different results. The age in our group of 50 patients ranged from 42-74 years (mean age 55.16±7.47) while a study conducted by Armstrong et al showed mean age as (54±10 years) [15,16].

30 (60%) of our patients were male and 20 (40%) were females. A slight higher trend towards the males was seen in various other studies.[17]

Armstrong et al [18] reported 68% males, Oyibo [19,20] reported 71% males, Mysliwiec et al [18] reported 65% male patients.

In present study we only included the patients with type II diabetes mellitus whereas other studies included the patients with both type of diabetes mellitus i.e. type-I as well as type-II. Armstrong et al [18, 21] reported 10% patients with type-I diabetes along with 90% patients of type-II diabetes mellitus in a random presentation at two clinics.

Oyibo et al [19, 22] reported 12% patients with type-I diabetes mellitus as a part of this study.

The duration of diagnosis of diabetes mellitus in present study was 6.98±3.24 years, whereas, duration of diabetes mellitus in other studies showed higher trends. They included the patients with type-I diabetes mellitus as well, who are younger than patients with diabetes mellitus type-II which is usually diagnosed after age of 40 years.

Oyibo et al [19, 23] reported mean duration of diabetes mellitus as 15.4±9.6 years and Armstrong et al [18] reported mean duration 14.2±9.5 years.

The evidence of neuropathy was detected in 30 (60%) of our study population while Oyibo et al [19] showed higher percentage of neuropathic foot, which was (67%) in his group of study.

80% of our patients had ulcers in the forefoot area and (10%) each at mid foot and hind foot level at their 1st presentation.

Oyibo et al [19,24] presented similar data in this regard with (78%) ulcers in forefoot area, (12%) at mid foot level and 10% at heel and

adjoining area while Armstrong et al [63] reported (90%) ulcers in forefoot area (4%) in the mid foot area and only (1%) at heel level.

When we compare these results with international study of Oyibo et al [64], which showed percentage number of unhealed ulcer as (8%) and percentage number of unhealed ulcers as (11%) subsequently with increasing grade it showed positive trends towards amputation and unhealed ulcers. [20].

Percentage number of amputation in Grade-II was (24%) and percentage number of unhealed ulcers in remaining patients was 20%.

Similarly Grade-III presentation showed percentage number of amputation as 36% and percentage number of unhealed ulcers in remaining patients as 20%. [5,21]

Oyibo et al [64] showed (50%) reduction in percentage number of amputation in Grade-IV whereas percentage number of unhealed ulcers was also (50%) in the remaining patients which were exactly half.

In our study all the patients 4 (8%) who presented with these ulcers in the heel area ultimately underwent some form of amputation, and these results are quite similar with a local study Ghafoor et al [66] which reported that wound of heel never heal in diabetics. [23,25]

## CONCLUSION

The results of this study indicate that outcomes deteriorate with increasing grade of Wagner classification system. As in this study we have shown a trend towards an increased prevalence of amputation with advancing depth and presence of infection.

- Osteomyelitis is a frequent cause of lower extremity amputation in high risk diabetic patients.
- The trends identified in this project strongly suggest that risk of amputation increases with advancing depth and there is an additive effect of infections.
- Systematic evaluation of the wound followed by appropriate therapy for a particular grade of diabetic foot wound have a definite impact on the outcome in majority of the patients.
- Ulcers over heels are very difficult to heal because of constant exposure to pressure, whereas ulcers on forefoot have generally been associated with less pressure from walking rather than constant pressure.
- Increased awareness of diabetic foot

problems, more effective screening, education, timely presentation, systematic evaluations and early intervention will eventually result in significant reductions in the incidence of foot ulcers and amputations.

## REFERENCES

1. Houghton AD, Taylor PR, Thurlows. Success rate for rehabilitation of vascular amputee. Implication for preoperative assessment and amputation level. *Br J Surg* 1992; 79: 753-5.
2. Walter JB. Some disorders of metabolism in general pathology. 6th ed. Hong Kong: Longman Group Ltd., 1990: 456-69.
3. Cuschieri SA. Diabetic foot disease in essential surgical practice higher surgical training in general surgery. 4th ed. London: 2002: 785-93.
4. Mysliwiec J, Zakrzewski M, Zarzycki W. Clinical classification of diabetic foot as a guideline for selection of treatment. *Pol Merkurius Lek* 2000; 9: 704-6.
5. Goldner MG. The fate of the second leg in the diabetic amputee. *Diabetes* 1960; 9: 100-3.
6. White-House FW, Jurgenson C, Black MA. The later life of diabetic amputee. *Diabetes* 1968; 7: 520-21.
7. Percoraro RE, Reiber GE, Burgers EM. Pathways to diabetic foot amputations: basis for prevention. *Diabetes Care* 1990; 13: 513-21.
8. Kornhauser C, Garcia-Ramirez JR, Wrobel K. Serum selenium and glutathione peroxidase concentrations in type 2 diabetes mellitus patients. *Prim Care Diabetes*, 2008, 2: 81-5.
9. Rooh UM, Mukhtar A, Samson G. Evaluation and management of Diabetic foot according to Wagner's Classification-a study of 100 cases. *J. Ayub. Med. Coll. Abbottabad*. 2003, 15(3):39-42
10. Wagner FW. Algorithms of diabetic foot care. In: Levin ME, O'Neil LW, editors. *The diabetic foot*. 2nd ed. St Louis: Mosby; 1983: 201-302.
11. Ghafoor A, Ahmed I. Treatment of non healing diabetic foot ulcers. *Pak Amred Forces Med J* 2002; 52: 17-20.
12. Ahmed M, Farooq A, Rehan TM, Yousaf M, Gill KM. Wounds of heel never heal in diabetics. *J Surg Pak* 2001; 6: 19-22.
13. Zheng Y, Li XK, Wang Y, Cai L. The role of zinc, copper and iron in the pathogenesis of diabetes and diabetic complications: therapeutic effects by chelators. *Hemoglobin*. 2008, 32: 135- 45.

14. Kalkan A, Bingol NK, Bulut V . Serum copper, zinc and selenium concentrations in brucellosis. Turk. J. Infect.2000, 14: 205- 8.
15. Wagner FW. The dysvascular foot: a system for diagnosis and treatment. J Foot Ankle Surg 1981 2: 64-122.
16. Vinik AI, Jenkins DJA. Dietary fibre in the management of diabetes. Diabetes Care 1988; 11: 160-
17. Aguilar MV, Saavedra P, Arrieta FJ . Plasma mineral content in type-2 diabetic patients and their association with the metabolic syndrome. Ann. Nutr. Metab.2007, 51:402–6.
18. Armstrong DG, Larvery LA, Harkless LB. Validation of a diabetic wound classification system. Diabetic Med 1998; 14: 855-9.
19. Oyibo S, Jude EB, Tarawheh I. A comparison of two diabetic foot ulcer classification systems, Wagner wound classification system and university of Texas wound classification system. Diabetes Care 2001; 24: 84-8.
20. Faris I, Dunean H, Yound C. Factors affecting outcome of diabetic patients with foot ulcer or gangrene. J Cardiovascular Surg 1988; 29: 736-4
21. Martin JD, Delbridge L, Reeve TS, Clagett GP. Radical treatment of malperforans in diabetic patient with arterial insufficiency. J Vascular Surg 1990; 12: 261-8.
22. Valko M, Morris H, Cronin MT . Metals, toxicity and oxidative stress. Curr. Med. Chem.2005, 12:1161–208.
23. Meyer JA, Spence DM . A perspective on the role of metals in diabetes: past findings and possible future directions. Metallomics.2009, 1:32–49.
24. Delbridge L, Ctercteko G, Fowler C, Reeve TS, Le Quense LP. The aetiology of diabetic neuropathic ulceration of the foot. Br J Surg 1985b; 72: 1-6.
25. Abdul HZ, Mir IB, Shariq RM . Copper, zinc and magnesium levels in type-1 diabetes mellitus. Saudi Med. J.2002, 23(5): 539-542