ORIGINAL ARTICLE

# Wagner Versus The University of Texas Classification Of Diabetic Foot Ulcers: A Descriptive Study In Nishter Hospital Multan

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*[1,3]Conception, planning of research and writing of manuscript, Discussion*
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**ABSTRACT**

**Objective:** The aim of this study was to compare two widely used classification systems "Wagner and university of Texas Classification" in description of diabetic ulcer.

**Study design:** Descriptive study

**Place and duration of study:** The study was conducted in surgical department of Nishtar Medical University and Hospital, Multan from January 2015 to January 2017

**Material and Methods:** All the patients with new foot ulcer because of diabetes either single or multiple on same foot or on both feet coming in OPD of Nishtar Medical University and Hospital were enrolled in this Descriptive study. Demographic data such as gender, age, diabetes duration, smoking, socioeconomic status, education level, hypertension and history of cardiovascular and cerebrovascular disease, and other chronic complications of diabetes were also recorded. Along with wound measurement grading was done using Wagner and university of Texas classification. Statistical analysis was performed by using SPSS version 21. To describe the data frequency tables, graphs and descriptive statistics like mean and standard deviation is used. For the purpose of analysis t test is used at 5% level of significance.

**Results:** One hundred individuals with diabetic foot ulcers were studied in 24-month period. Demographic and clinical data depicts presence of neuropathy in 67 patients (67%). Ischemic limb was diagnosed in 26 patients (26%). 34 patients got amputation (34%) while in 17 patients healing was problematic. There were no major amputations. None were lost to follow-up and none died. A significant number of our patients were lower socioeconomic status and was having no education. When results of both the classification were compared by using student t test (p value indicates no statistical significance >0.05)

**Conclusion:** This study confirmed that both classification systems are equally good in description of diabetic foot ulcer.

**Key words:** Wagner Classification, University Of Texas Classification, Diabetic Foot Ulcers

## Introduction

Diabetes mellitus is one of the major health problems worldwide and has recently reached to the level of an epidemic in both developed and developing countries. Lower limb complications related to diabetes mellitus not only severely affected the life of a person but also has enormous economic consequences. It has been found that 2.8% of total world population has diabetes mellitus in 2000 and in 2030, the prevalence of diabetes in all age-

groups worldwide is estimated to be 4.4% (i.e.171 million in 2000 to 366 million in 2030). WHO reports that the prevalence of diabetes is higher in men than women, but now it has been found that more women are affected with diabetes than men and in developing counties urban population is projected to double between 2000 and 2030. It has been estimated that the number of diabetic people in Pakistan may reach 14.4 million by 2040.[1,2] Foot ulcers are one the most important complications of diabetes mellitus. The annual incidence of foot ulcers is approximately 2% of the diabetic population. [3,4] Foot ulcers are much more common in patients with predisposing risk factors like peripheral neuropathy (annual incidence rates vary from 5% to over 7% [5,6] ), microangiopathy and macroangiopathy, [6] history of previous foot ulcers (annual incidence rates is 5%)[7]. The incidence of overall lifetime risk of developing foot ulcer cumulative lifetime incidence may be as high as 15%.[8] Pathophysiology of foot ulcers show that rarely a single pathology is cause of diabetic foot ulcer , rather it is because of the interaction of two or more contributory causes like peripheral neuropathy, angiopathy and infection that lead to the foot ulcers.[9] Peripheral neuropathy of foot in diabetes is not a sole factor which lead to spontaneous ulceration of foot, rather there is a combination of insensate sole and either extrinsic factors or intrinsic factors. Extrinsic factors like bare foot and unnoticed trauma because of stepping on a sharp object or simply bad shoes are equally important as intrinsic factors like patient with insensate foot and callus in causation of ulceration. Among all the described factors Peripheral neuropathy is the most important in causation of ulceration.[10] In the literature, incidence of Peripheral neuropathy in diabetic population is more than 30 %. Ulcers that appear as a sequela of peripheral neuropathy have dry skin, loss of the protective sensations and reduced joint mobility. Ischemic effects of macroangiopathy and microangiopathy increases the likely hood of foot ulcer. Infections later worsen the condition leading to a lower-limb amputation .[15,16,17] Wound healing is impaired in diabetes because of poor foot circulation, altered white cell function, cytokines and proteases balance is disturbed, chronic hyperglycemia itself and offloading.[11,12] Poor predictors of diabetic foot ulcers are Infection, angiopathies, and increasing wound depth.

To describe the Diabetic foot ulcer various classifications have been described with an aim to standardize the management. These classifications are based on site, depth, neuropathy, infection, and ischemia, etc. It also appears that the progressive cumulative effect of these comorbidities contributes to a greater likelihood of a diabetic foot ulcer leading to a lower-limb amputation. Among these classification systems Wagner wound classification system[13] and University of Texas classification [12] are popular. Wagner classification is based on the depth of the wound, osteomyelitis or gangrene and tissue necrosis. University of Texas classification is based on the depth of wound, infection and / or ischemia.

## Methodology

After approval from the local ethics committee, this Descriptive study was conducted in surgical department Nishtar Medical University and Hospital, Multan from January 2015 to January 2017.A sample of 100 patients coming in OPD of Nishtar Hospital Multan with new foot ulcer because of diabetes either single or multiple on same foot or on both feet were collected .we excluded those patients who had a history of previous diabetic foot ulcer and got treatment either an ulcer healed or foot amputation. All the patients who fulfilled the inclusion criteria were given all the details about this study and written consent was taken. Demographic data such as gender, age, diabetes duration, smoking, socioeconomic status, education level, hypertension and history of cardiovascular and cerebrovascular disease, and other chronic complications of diabetes were also recorded.

Management of these patients were supervised primarily by a consultant plastic and a consultant general surgeon. Other members of the team were a physician, orthopedic surgeon, vascular surgeon and orthoptist. Site of Diabetic foot ulcer was first noted and photographed. If more than one ulcer at the same time (one foot) was found the largest ulcer was taken as index ulcer for the purpose of study. After wound debridement, elliptical method of wound measurement as described by Shaw et al (2007) was done. In this method, wounds tracings were taken

and then its measurements were taken. Measurement of surface area of wound was calculated by formula $\pi$ ab

a radius of the longest side of the ellipse (wound)

b radius of the shortest side of the ellipse (wound)

$\pi$ (where $\pi = 3.14$) and r is the radius measurement.

The wound depth calculation was by inspection and using a sterile blunt probe.

Ulcer depth Grades were based on skin (intact or breached), wound deep into subcutaneous tissue, tendon, bone or or joint space. Diagnosis of osteomyelitis was made by Presence of infection (local or systemic), bone deep wound and radiologically. Diagnosis of Ulcer infection was done on signs of inflammation and discharge. Ischemia of foot was determined by palpation of the dorsalis and posterior tibial foot pulses. In case of diminished or impalpable pulses, we got ankle-brachial pressure index (ABPI $<$ 0.9 indicate arterial disease). Patient was referred to vascular surgeon if any sign of ischemia was found. Peripheral neuropathy in the diabetic foot ulceration was found using point pressure (Semmes-Weinstein 10 g monofilament), ankle reflexes and tuning fork test of 128-Hz on the tip of the toe.

Each ulcer was graded using both classification systems.

**Wagner Classification of Diabetic Foot[13]**

Grade 0 Foot symptoms like pain only
Grade 1 Superficial ulcers
Grade 2 Deep ulcers
Grade 3 Ulcer with bone involvement
Grade 4 Forefoot gangrene
Grade 5 Full foot gangrene

**University of Texas Classification of Diabetic Foot[14]**

Stage-A
Grade-0 Epithelialized
Grade-1 Superficial wound
Grade-2 Wound to tendon
Grade-3 Wound to bone or joint

Stage-B
Grade-0 Epithelialized +Infection
Grade-1 Superficial wound+ Infection
Grade-2 Wound to tendon +Infection
Grade-3 Wound to bone or joint +Infection

Stage-C
Grade-0 Epithelialized + Ischemia
Grade-1 Superficial wound+ Ischemia
Grade-2 Wound to tendon + Ischemia
Grade-3 Wound to bone or joint + Ischemia

Stage-D
Grade-0 Epithelialized + Infection + ischemia
Grade-1 Superficial wound+ Infection + ischemia
Grade-2 Wound to tendon + Infection + ischemia
Grade-3 Wound to bone or joint + Infection + ischemia

After wound debridement patient was counseled about the care of wound. The orthotist helped to off-load the ulcerated area. Follow up was done on weekly basis. Outcome parameters were ulcer healing, with or without minor or major amputation after at least 6-month follow-up. By definition a minor amputation is any amputation which is distal to the ankle joint while the major amputation defines as any amputation through or proximal to the ankle joint. Statistical analysis was performed by using SPSS version 21. To describe the data frequency tables, graphs and descriptive statistics like mean and standard deviation is used. For the purpose of analysis t test is used at 5% level of significance. Conclusions were drawn accordingly.

## Results

During 22 months period, 100 individuals with diabetic foot ulcers were studied. Male population dominated in our study. Demographic and clinical data is summarized in table I. The data depicts that 48 % patients are in the age range of 61-70 years. Most of our patients were in low socioeconomic status with low and had no education. Comorbidities which were associated with our studied population were hypertension, coronary artery disease and renal diseases. Low socioeconomic status with low and no education and comorbidities and almost the same results.in our population distal neuropathy was present in 67 % of the cases. A peripheral arterial disease was present in 26 % of patients. Most common site of ulcer formation was planter aspect of forefoot. Wagner classification and the university of Texas classification system are elaborated in table II and table III and the percentages outcome in terms of unhealed ulcer and amputations are also shown. None were lost to follow-up and none died.

| Table I: Demographic Analysis | | | |
|---|---|---|---|
| Gender of patients | | **Number of patients** | **Percentage** |
| | **Male** | 66 | 66% |
| | **Female** | 34 | 34% |
| | Total | 100 | 100% |
| Age of patients | | **Number of patients** | **%age** |
| | **< 40 years** | 4 | 4% |
| | **41-50 years** | 28 | 28% |
| | **51-60 years** | 48 | 48% |
| | **61-70 years** | 16 | 16% |
| | **> 70 years** | 4 | 4% |
| | **Total** | 100 | 100% |
| Socioeconomic status | | **Number of patients** | **%age** |
| | Upper | 10 | 10% |
| | Middle | 30 | 30% |
| | Low | 60 | 60% |
| | **Total** | 100 | 100% |
| Educational level | | **Number of patients** | **%age** |
| | Nil | 51 | 51% |
| | primary | 33 | 33% |
| | secondary & higher | 16 | 16% |
| | **Total** | 100 | 100% |
| Diabeties Mellitis control | | **Number of patients** | **%age** |
| | No | 58 | 58% |
| | Yes | 42 | 42% |
| | **Total** | 100 | 100% |
| Duration of Diabeties Mellitis | | **Number of patients** | **%age** |
| | 5-10 years | 30 | 30% |
| | 11-15 years | 28 | 28% |
| | >15 years | 42 | 42% |
| | **Total** | 100 | 100% |
| smoking | | **Number of patients** | **%age** |
| | No | 60 | 60% |
| | Yes | 40 | 40% |
| | **Total** | 100 | 100% |
| Hypertension | | **Number of patients** | **%age** |
| | No | 40 | 40% |
| | Yes | 60 | 60% |
| | **Total** | 100 | 100% |
| Coronary artery disease | | **Number of patients** | **%age** |
| | No | 45 | 45% |
| | Yes | 55 | 55% |
| | **Total** | 100 | 100% |
| Renal | | **Number of patients** | **%age** |
| | Yes | 15 | 15% |
| | No | 85 | 85% |
| | **Total** | 100 | 100% |
| **Distal sensory neuropathy ? (n=67)** | | | |
| **Peripheral arterial disease / Ischaemia (pulses diminished or impalpable) / ABPI < 0.9** [26] | | | |
| **Site of ulcers** | Plantar ulcer | Dorsal ulcer | Both Plantar & Dorsal ulcer |
| Forefoot (n=77) | **57** | **15** | **5** |
| Midfoot (n=12) | **9** | **2** | **1** |
| Hindfoot (n=11) | **10** | **1** | **-** |
| Total (n=100) | **76 %** | **18%** | **6%** |
| **Ulcer size ($cm^2$)** Minimum=0.90$cm^2$ Maximum=4.00 $cm^2$ Mean = 2.28 $cm^2$ Std. Deviation=1.01 $cm^2$ | | | |

| Table II: Foot Ulcers, Amputations, And Non-Healed Ulcers in the Wagner grade | | | |
|---|---|---|---|
| Wagner grade | foot ulcers | Amputations | Unhealed ulcers |
| Grade 1 | 67% | 13% | 7% |
| Grade 2 | 12% | 7% | 3% |
| Grade 3 | 18% | 11% | 7% |
| Grade 4 | 3% | 3% | |
| Grade 5 | 0 | 0 | |
| **Total** | 100 | 34 | 17 |

| Table III: Foot ulcers, amputations, and non-healed ulcers in the University of Texas grade and stage | | | |
|---|---|---|---|
| University of Texas grade and stage | foot ulcers | Amputations | Unhealed ulcers |
| **Stage A** | | | |
| Grade 1 | 44 % | 10% | 5% |
| Grade 2 | 1% | | 1% |
| Grade 3 | 1% | | 1% |
| **Stage B** | | | |
| Grade 1 | 9% | 2% | 2% |
| Grade 2 | 10% | 4% | 3% |
| Grade 3 | 7% | 4% | 1% |
| **Stage C** | | | |
| Grade 1 | 9% | 6% | 3% |
| Grade 2 | 1% | | 1% |
| Grade 3 | 1% | | 1% |
| **Stage D** | | | |
| Grade 1 | 6% | 3% | |
| Grade 2 | 8% | 4% | 1% |
| Grade 3 | 3% | 1% | |

## Discussion

Diabetes is now challenge for healthcare system throughout the world but for developing countries like Pakistan where economic and social situations are not in a position to counter this problem in a better way. The most common complication of diabetes is foot ulcer which is associated with high morbidity and mortality.

This complication not only increase the financial burden but also has sever effect on the on the patient's quality of life.[25] Foot ulcers become infected and lead to progressive necrosis and end up with amputations which decrease the productivity of individual. [26] Diabetes mellitus is also associated with commodities which certainly affect the management of foot ulcer. WHO emphasizes on preventive strategies which not only decrease morbidity but also improve the limb status. [27,28,29] The foot ulcers are diverse in their clinical presentation for this reason no single classification is perfect. The diversity of clinical presentation of diabetic foot also does not allow formulating a uniform approach to the management strategies. Another issue in this aspect is population studied may be different and regional diversity hampers the uniformity of management.[30] Factors which increase the chance of further foot ulcers, infections and amputations in diabetic foot are uncontrolled diabetes, current ulcer, previous foot ulcer, previous lower limb amputations, uncontrolled diabetes, lack of knowledge of preventive measures. [23,24] In 1970 Wagner classification was devised soon after that it became popular. Since then it was used universally for grading of diabetic foot. Literature review highlighted the short comings of Wagner's classification as this classification does not address the infections associated with diabetic foot.[18] Only grade 3 out of six grades of Wagner classification address infections. Another problem with Wagner classification was that it cannot encompass all the phenotypes of diabetic foot. This classification does not identify and describe ischemic limb secondary to microangiopathy and macroangiopathy. In addition,

superficial wounds in grade 1 that are infected or has ischemic element cannot be classified by this system. Wagner's classification is anatomical, On the other hand, the size and depth of ulcer, infection, ischemia and a combination of ischemia and infection, form the basis of the University of Texas classification system.

In our study male population was more than females with a large population 50-60 year of age. Most of our patients were in low socioeconomic status with a 51% of patients having no education. In a large population control of diabetes was very low. These figures are very much similar to other published data.[25] The study demonstrates the incidence of neuropathy and ischemia that may be different from studies published in higher socioeconomic countries.[12,19,23] In current study diabetic foot ulcers were classified using the Wagner and the university of taxis classification by the same team and the outcome in terms of wound healing and amputation was measured and compared. Both of these classifications performed equally well in our study. The University of Texas classification [has] been devised with the intensions to solve problems associated with wagner classification. This system addresses ischemia and infections in all the grades. This system has now become popular and its validity and predictive outcome has been accepted. This has been shown that with increasing grades and stage incidence of wound healing decrease. This has now become a valid tool in diabetic clinics.[19,20] However This study assessed and compared Wagner and The University of Texas classification terms of validity and predictive outcomes. Despite all the above discussion, it was found that both classification systems are the same and grade of Wagner matches with grade of University of Texas classification.

## Conclusion

This study also confirmed that diabetic foot ulcers is quite prevalent among diabetic population and thus, foot care education would be the most important way of dealing with this major problem. This present study has shown the relationship between the grades of foot ulcers at the time of presentation with the outcome. The higher the grade, the greater the number of amputations done, but staging used in The University of Texas classification made it more descriptive and helped further in predicting the outcome of diabetic foot ulcer.

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