

**Testing And Validating Amit Jain's Classification And Scoring System For Diabetic Foot Complications**Amit Kumar C Jain¹, Rajagopalan², Gopal S³¹Associate Professor, Department Of Surgery, Rajarajeswari Medical College, Bangalore, India²Professor and HOD, Department Of Surgery, Rajarajeswari Medical College, Bangalore, India³ Assistant Professor, Department Of Surgery, Rajarajeswari Medical College, Bangalore, India**Correspondence Author:** Dr. Gopal S, Assistant Professor, Department Of Surgery, Rajarajeswari Medical College, Bangalore, India**Type of publication:** Original Research Paper**Conflicts of Interest:** Nil**Abstract****AIM** - The study aims at testing and validating Amit Jain's classification and Amit Jain's scoring system for diabetic foot complication.**Methods And Materials** - A prospective descriptive analysis was done in Department of Surgery of Rajarajeswari medical college, Bangalore, India. The study period was for one year from January 2017 to December 2017.**results** - A total of 61 patients were included in this study. Majority of the patients were males [73.8%] in this study. Majority of the patients belonged to Type 1 diabetic foot complications [67.2%] followed by type 3 diabetic foot complication [29.5%] and it was statistically significant (P<0.001). Wet gangrene was most common pathological lesion seen in 24.6% followed by abscess which was seen in 23%. Majority of diabetic foot patients [68.9%] had a score between 6-10 and were in low risk category of major amputation. There were two mortality in this study and it was associated with high scores {22.00+/-11.31, P<0.001} and it was statistically significant.**Conclusion** - In this validation study, it is clearly seen that type 1 diabetic foot complications accounts for significant number of cases admitted in hospitals with wet gangrene and abscess being the commonest lesions seen.

Most of the major amputations were performed in type 1 diabetic foot complication. It was found that with increasing scores for diabetic foot, there was statistically significant increase in major amputation. Patients with mortality also had significant higher scores.

Keywords: Diabetic foot, Amit Jain's, Classification, Scoring, Amputation**Introduction**

The incidence of diabetes around the world has quadrupled in last 30 years with 422 million of people now diagnosed with disease, increasing the global prevalence from 4.7% to 8.5% [1]. However, the burden of diabetes is likely to be greater than current forecasts [2]. Diabetic foot is considered to be one of the most significant complications of diabetes, representing a major worldwide medical, social and economic problem that greatly affects the quality of life of the patient [3]. The morbidity and mortality associated with diabetic foot problem remains extremely high [4].

It is estimated that around 15% of people with diabetes will develop foot ulcers during their lifetime [2, 5].

A number of foot ulcer classification systems have been devised over years to categorize ulcers more effectively [6]. Amit Jain's classification for a diabetic foot complication [Table1] is a new modern comprehensive

classification for diabetic foot that divides diabetic foot into 3 simple types [2, 5, 7, 8]. Amit Jain's scoring system [Table 2] is a new surgical scoring system that predicts a risk of major amputation in diabetic foot [9, 10].

This study aims at testing and validating Amit Jain's classification and Amit Jain's scoring system for diabetic foot complication.

Methods And Materials

A prospective descriptive analysis was done in Department of Surgery of Rajarajeswari medical college, Bangalore, India. This is a tertiary care teaching hospital mainly serving rural population. The study period was for one year from January 2017 to December 2017. All the patients admitted and operated for diabetic foot complication were included in the study and their data was entered in study performa.

The following were the *exclusion criteria*

- 1] Patients who refused surgery and were discharged against medical advice
- 2] Patients operated in other specialty department
- 3] Patients operated elsewhere
- 4] Patients admitted for skin grafting

The study was approved by our institutional ethics committee [RRMCH-IEC/157/2016-17]

Statistical Methods: Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean \pm SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. The following assumptions on data is made, **Assumptions:** 1. Dependent variables should be normally distributed, 2. Samples drawn from the population should be random, Cases of the samples should be independent

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous

scale between two groups (Inter group analysis) on metric parameters. Leven1s test for homogeneity of variance has been performed to assess the homogeneity of variance. Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis. Fisher Exact test used when cell samples are very small.

Significant figures

+ Suggestive significance (P value: $0.05 < P < 0.10$)

* Moderately significant (P value: $0.01 < P \leq 0.05$)

** Strongly significant (P value : $P \leq 0.01$)

Statistical software: The Statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Results

A total of 61 patients were included in this study. Majority of the patients were males [73.8%] in this study [Table 3]. Most patients were in age [Table 4] ranging from 5 to 60 years [56.92 \pm 11.92]. Left foot was the commonest side involved affecting 38 patients [62.3%].

Wet gangrene [Table 5] was most common pathological lesion seen in 24.6% followed by abscess [Figure 1] which was seen in 23%. Majority of the patients thus belonged to Type 1 diabetic foot complications [67.2%] followed by type 3 diabetic foot complication [29.5%] and it was statistically significant ($P < 0.001$). Debridement is the most common surgical procedure done [Table 6]. 32 patients [52.5%] had some type of amputation being performed. There was no significant association between amputation done [Table 7] and type of diabetic foot

complication [P+0.241]. Among amputations, 6 patients [9.8%] had major amputation [Table 8].

Majority of diabetic foot patients [68.9%] had a score between 6 to 10 and were in low risk category of major amputation. It was seen that, with increasing score, the risk of major amputation [Table 9] increased significantly [P<0.001]. There were 6 major amputation with all having score above 16. All patients who had score above 25 invariably had major amputation done. Patients with type 2 diabetic foot complication [Table 10] had higher scores compared to other complication suggesting significance [19.50+/-10.61, P-0.040].

.Majority of patients [34.4%] had diabetes [Table 11] of 6-10 years duration [8.57+/- 6.68]. 42.6% had associated hypertension [Table 12], 4.9% had chronic kidney disease [Table 13] and 9.8% had ischemic heart disease [Table 14]. It was seen that patients with type 3 diabetic foot complication had longer duration of diabetes suggesting some significance [10.89+/-7.53, P-0.088].

There were two mortality [Table 15] in this study and it was associated with high scores {22.00+/-11.31, P<0.001} and it was statistically significant [Table 16].

Discussion

Various classifications and scoring system have been proposed in diabetic foot with most of them focusing only on diabetic foot ulcers [2, 5, 7, 8]. Some of the classifications are Wagner's classification, University of Texas classification, PEDIS classification whereas some of the known scoring system are DEPA scoring system, DUSS, etc [2, 5, 7, 8, 11, 12].

It is now clear that there is a difference between a classification and a scoring [12]. A classification is descriptive in nature, whereas a score is a numerical descriptor and is usually meant to give an idea of severity [12]. It is also known that it is very difficult to see how a single classification system can do both of these [12]. The

current study thus employed Amit Jain's classification for diabetic foot complication and Amit Jain's scoring system which predicts the risk of major amputation in diabetic foot complication [7, 8, 9, 10].

The Amit Jain's classification for diabetic foot complication was first proposed in 2017 which was the first classification that encompassed all lesions seen universally [7, 8, 13, 14]. Initially, no studies were done on this classification when it was first proposed [7]. Later, many new studies were done on this classification. Various studies showed that type 1 diabetic foot complications were the most common cause for admission [13, 14, 15]. In Jain et al series, it was seen that 86.67% of admitted patients had type 1 diabetic foot complication whereas in Kalaivani et al series it was 91.06% [13, 15]. Wet gangrene and abscess was the most common lesion seen in different studies [2, 13, 14, 15]. In this series also, wet gangrene followed by abscess were the 2 most common lesion encountered. More than 67% of the patients had type 1 diabetic foot complication and it was very significant statistically in this study.

Majority of the studies showed that most common reason for major amputation was type 1 diabetic foot complication [2, 13, 15]. In this study too, major amputation was most common type 1 diabetic foot complication. In a validation study on Amit Jain's scoring by kalaivani et al [16], it was seen that more than 85.7% of patients who had major amputation had score of more than 16 whereas in Jain et al series, more than 80 of patients with major amputation had score of 16 and above [17].

In our series, we found that there is a significant association of Amit Jain's scoring system with major amputation. The higher the scores, more the major amputations. Further, there was a significant association of mortality with higher score. Type 2 diabetic foot

complications had significantly higher scores overall when compared to other types of complication.

In Jain et al series [17] on the scoring system, mortality was associated with higher scores. Even the stump complications following major amputation were more common in type 1 diabetic foot complication and were seen more in patients with higher scores in earlier studies [10]. With so many studies done on Amit Jain's classification over past 4 to 5 years, Nather et al [18] in its recent review on classification on diabetic foot, failed to analyze all the above studies done on Amit Jain's classification.

Conclusion

In this validation study, it is clearly seen that type 1 diabetic foot complications accounts for significant number of cases admitted in hospitals with wet gangrene and abscess being the commonest lesions seen. Most of the major amputations were performed in type 1 diabetic foot complication. It was found that with increasing scores for diabetic foot, there was statistically significant increase in major amputation. Patients with mortality also had significant higher scores. With already many studies done on Amit Jain's classification and scoring system, further studies in future on this combined classification and scoring done from different center's will lend creditability and provide new data.

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FIGURES

Figure 1: Showing Right Side Diabetic Foot Abscess. This Is Amit Jain's Type 1 Diabetic Foot Complication



Tables and Graphs

Table 1: Amit Jain's classification for diabetic foot complication.

SL NO	TYPE OF DIABETIC FOOT COMPLICATION	LESIONS
1]	TYPE 1 DIABETIC FOOT COMPLICATION [INFECTIVE]	ABSCCESS, CELLULITIS, WET GANGRENE, NECROTIZING FASCIITIS, ETC
2]	TYPE 2 DIABETIC FOOT COMPLICATION [NON INFECTIVE]	TROPHIC ULCER, CHARCOT FOOT, CLAW TOE, HAMMER TOE, DRY GANGRENE, MALLET TOE, ETC
3]	TYPE 3 DIABETIC FOOT COMPLICATION [MIXED]	EX – TROPHIC ULCER WITH OSTEOMYEELITIS

Table 2 –Amit Jain’s scoring system

SL NO	CHARACTERISTICS	INVOLVEMENT OF FOOT			
1]	PRESENCE OF ULCER	NO ULCER → 0	FOREFOOT ULCER → 2	MIDFOOT ULCER → 4	HINDFOOT ULCER/ FULL FOOT/BEYOUND → 6
2]	OSTEOMYELITIS [O.M]	NO O.M → 0	FOREFOOT O.M → 2	MIDFOOT O.M → 4	HINDFOOT O.M → 6
3]	PRESENCE OF PUS	NO PUS → 0	FOREFOOT PUS/DORSUM → 2	MIDFOOT PUS → 4	HINDFOOT PUS/BEYOND IT → 6
4]	GANGRENE [DRY/WET]	NO GANGRENE → 0	FOREFOOT GANGRENE → 2	MIDFOOT GANGRENE → 4	HINDFOOT GANGRENE/BEYOND → 8
5]	PERIPHERAL ARTERIAL DISEASE	NO P.A.D → 0	MILD → 2	MODERATE → 4	SEVERE → 8
6]	CHARCOT FOOT/ DESTROYED JOINTS	NO → 0	FOREFOOT → 2	MIDFOOT → 4	HINDFOOT/WHOLE FOOT → 8
7]	NECROSIS [SKIN]	NO → 0	FOREFOOT NECROSIS → 2	MIDFOOT NECROSIS → 4	HINDFOOT NECROSIS/BEYOND → 8
8]	ASSOCIATED CELLULITIS	NO → 0	UPTO FOREFOOT → 2	UPTO MIDFOOT → 4	UPTO HINDFOOT & BEYOND → 6
9]	PREVIOUS AMPUTATION	NO → 0	TOE AMPUTATION	FOREFOOT AMPUTATION	MIDFOOT AMPUTATION → 6

			N → 2	→ 4	
10]	PRESENCE OF GAS – RADIOLOGICALLY	NO → 0	GAS IN FOREFOOT → 1	GAS IN/UPTO MIDFOOT → 2	GAS IN/UPTO HINDFOOT → 3
11]	MYONECROSIS	NO → 0	MYONECROSIS INVOLVING SINGLE MUSCLE GROUP → 2	MYONECROSIS INVOLVING MORE THAN ONE GROUP → 4	MYONECROSIS OF ENTIRE FOOT WITH EXTENSION TO LEG → 8
12]	JOINT INVOLVEMENT	NO → 0	FOREFOOT JOINT EXPOSURE → 2	MIDFOOT JOINT EXPOSURE → 4	HINDFOOT JOINT EXPOSURE → 6
13]	SEPTIC SHOCK	NO → 0		PRESENT → 2	
14]	RENAL FAILURE [ACUTE]	NO → 0		PRESENT → 2	
15]	SMOKING [HEAVY SMOKER]	NO → 0		PRESENT → 2	
16]	SURGEON FACTOR	PODIATRIC/DIABETIC FOOT SURGEON → 0		OTHER SURGEONS → 2	

Table 3: Gender distribution of patients studied

Gender	No. of patients	%
Male	45	73.8
Female	16	26.2
Total	61	100.0

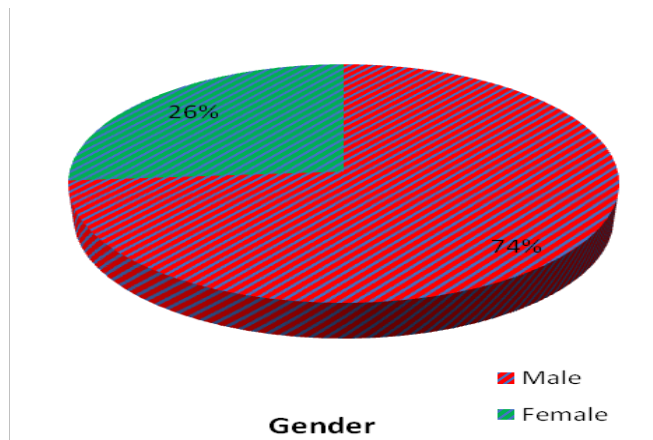


Table 4: Age distribution of patients studied

Age in years	No. of patients	%
30-40	4	6.6
41-50	19	31.1
51-60	16	26.2
61-70	15	24.6
>70	7	11.5
Total	61	100.0

Mean ± SD: 56.92±11.92

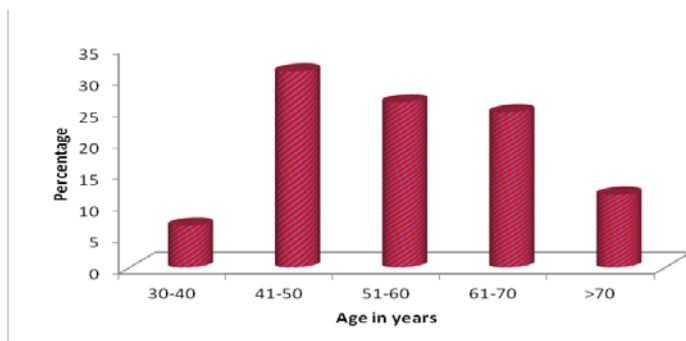


Table 5: Distribution of cases according to type of complication.

Variables	Type 1 complication	Type 2 complications	Type 3 complications	Total (n=61)	P value
• Abscess	14(34.1%)	0(0%)	0(0%)	14(23%)	<0.001**
• Wet gangrene	15(36.6%)	0(0%)	0(0%)	15(24.6%)	
• Necrotizing fasciitis	6(14.6%)	0(0%)	0(0%)	6(9.8%)	
• Cellulitis	6(14.6%)	0(0%)	0(0%)	6(9.8%)	
• Dry gangrene	0(0%)	2(100%)	0(0%)	2(3.3%)	
• Infected ulcer with osteomyelitis	0(0%)	0(0%)	7(38.9%)	7(11.5%)	
• Infected ulcer without osteomyelitis	0(0%)	0(0%)	11(61.1%)	11(18%)	

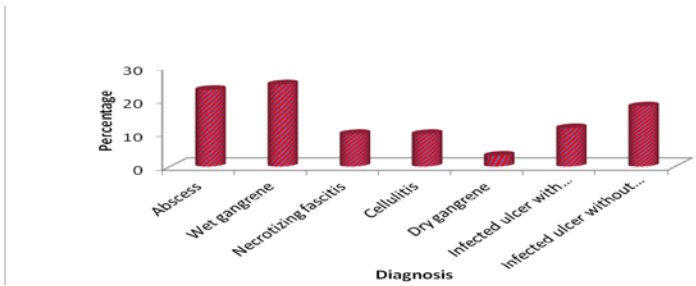


Table 6: Surgery distribution of patients studied

Surgery	No. of patients	%
Debridement	29	47.5
Toe amputations	15	24.6
Transmetatarsal amputation	11	18.0
Below knee amputation	2	3.3
Above knee amputation	4	6.6
Total	61	100.0

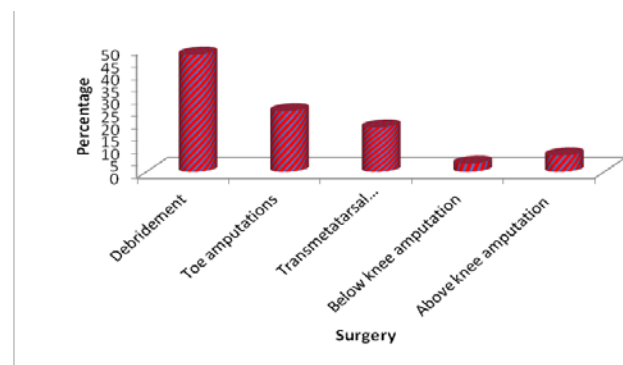


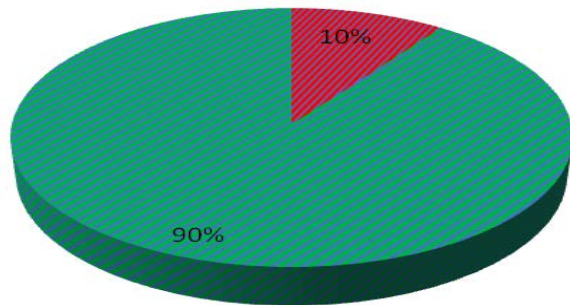
Table 7: Amputation done in relation to Type of complications of patients studied

Amputation done	Type of Complications			Total
	1	2	3	
Yes	19(46.3%)	2(100%)	11(61.1%)	32(52.5%)
No	22(53.7%)	0(0%)	7(38.9%)	29(47.5%)
Total	41(100%)	2(100%)	18(100%)	61(100%)

P=0.241, Not Significant, Fisher Exact Test

Table 8: Major Amputation distribution of patients studied

Major Amputation	No. of patients	%
Yes	6	9.8
No	55	90.2
Total	61	100.0



Major Amputation

Yes No

Table 9: Score of Diabetic Foot Amputation in relation to Major amputation of patients studied

Score of Diabetic Foot Amputation	Major amputation		Total
	Yes	No	
1-5	0(0%)	2(3.6%)	2(3.3%)
6-10	0(0%)	42(76.4%)	42(68.9%)
11-15	0(0%)	8(14.5%)	8(13.1%)
16-20	1(16.7%)	3(5.5%)	4(6.6%)
21-25	2(33.3%)	0(0%)	2(3.3%)
>25	3(50%)	0(0%)	3(4.9%)
Total	6(100%)	55(100%)	61(100%)

P<0.001**, Significant, Fisher Exact Test

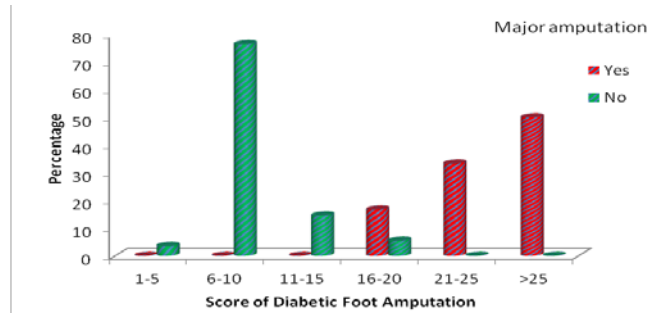


Table 10: Comparison of clinical variables according to Type of complications of patients studied

variables	Type of Complications			Total	P value
	1	2	3		
Age in years	56.93±1.205	53.00±4.24	57.33±1.251	56.92±1.192	0.891
DM Duration	7.90±6.11	1.50±0.71	10.89±7.53	8.57±6.68	0.088+
Score of Diabetic Foot Amputation	10.07±5.47	19.50±1.61	9.11±4.50	10.10±5.55	0.040*

Table 11: DM Duration distribution of patients studied

DM Duration(years)	No. of patients	%
1-2	14	23.0
3-5	9	14.8
6-10	21	34.4
11-15	8	13.1
16-20	6	9.8
21-25	2	3.3
26-30	1	1.6
Total	61	100.0

Mean ± SD: 8.57±6.68

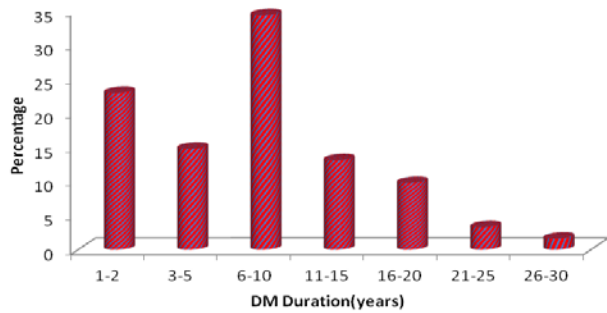


Table 12: Hypertension distribution of patients studied

Hypertension	No. of patients	%
Yes	26	42.6
No	35	57.4
Total	61	100.0

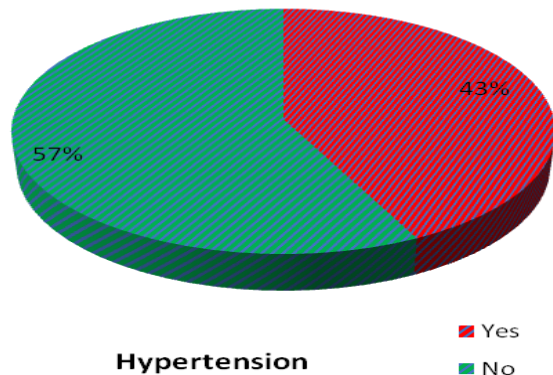


Table 13: CKD distribution of patients studied

CKD	No. of patients	%
Yes	3	4.9
No	58	95.1
Total	61	100.0

Table 14: IHD distribution of patients studied

IHD	No. of patients	%
Yes	6	9.8
No	55	90.2
Total	61	100.0

Table 15: Mortality distribution of patients studied

Mortality	No. of patients	%
Yes	2	3.3
No	59	96.7
Total	61	100.0



Table 16: Comparison of scores with Mortality of patients studied

variables	Mortality		Total	P value
	Yes	No		
Score of Diabetic Foot Amputation	22.00±11.31	9.69±4.96	10.10±5.55	0.001* *