



# International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958  
P-ISSN: 2706-6630  
IJOS 2020; 6(2): 43-49  
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[www.orthopaper.com](http://www.orthopaper.com)  
Received: 26-02-2020  
Accepted: 27-03-2020

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## To determine the acute stump complications in major amputation occurring in hospitalized diabetic foot patients through Amit Jain's typing and scoring system: A prospective study

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**DOI:** <https://doi.org/10.22271/ortho.2020.v6.i2a.2017>

### Abstract

**Aim:** To study the stump complications occurring in patients with major amputations in diabetic foot and analyze them through Amit Jain's classification for diabetic foot complication and Amit Jain's scoring system.

**Methods and Material:** A prospective study was conducted in Department of surgery of Rajarajeswari medical college, Bengaluru, India. The study period was from June 2018 to may 2019. An IEC approval was obtained for this study.

**Results:** A total of 15 patients who underwent major amputation were included in the study and majority of them were males. Around 86.7% of the patients were above 50 years of age. 60% of the major amputation were done in type 1 diabetic foot complication. 80% of patients underwent below knee amputation. 73.4% of the patients with major amputation had score of 16 and above. 66.7% of the patients had some form of stump complication after major amputation and they occurred significantly in patients who had score of 16 and above. Around 66.7 % of patients had their stump closed after major amputations and 80 % of them were significantly done in type 1 diabetic foot complications.

**Conclusion:** In this study that utilizes Amit Jain's universal classification and scoring system, type 1 diabetic foot complications were the commonest cause for major amputation. Below knee amputation was the most common type of major amputation. Majority of the patients developed some form of stump complication after major amputation. Most major amputations were done in patients who had a score of 16 and above and the stump complications was statistically significant in patients whose score was 16 and above.

**Keywords:** Diabetes, foot, amputation, stump, infection, scoring, Amit Jain, classification, universal

### Introduction

Amputation, which is a debilitating procedure, was believed to be first performed by the Hammurabi tribe in Babylon as a form of punishment and it was later implemented by Hippocrates as a surgical procedure to save life, more than 2500 years ago [1, 2]. Today, with growing incidence of diabetes worldwide, the diabetic foot remains one of the common causes of lower limb amputation. In fact, patients with diabetes are 10 times at a higher risk of amputations than non-diabetics [3].

Around 40 -70% of all the lower extremity amputations are attributed to diabetes mellitus [4]. Often, amputation of lower limb affect's one's ability to walk along with impairment in quality of life [5]. In amputations for diabetic foot complications, it is often preferred to be a minor amputation over major amputation [6]. Amputation performed at or below ankle joint are considered to be minor amputations whereas amputation above ankle joint are major amputations [1, 6, 7].

Major amputations are often associated with increased morbidity and mortality compared to minor amputation [6, 8, 9]. One such problem with major amputation is stump complication.

This study was aimed to analyze and study the stump complications occurring in major amputation in diabetic foot patients and to distribute it through Amit Jain's typing and scoring system [9, 10, 11, 12]. Amit Jain's universal classification is a simple, descriptive 3 tier classification that divides diabetic foot complications into 3 simple types which encompasses

most of the common lesion seen in diabetic foot worldwide [Figure 1] and Amit Jain’s surgical scoring system is a new scoring system [Table 1] for diabetic foot complication that

predicts the risk of major amputation and both were proposed from Indian subcontinent.

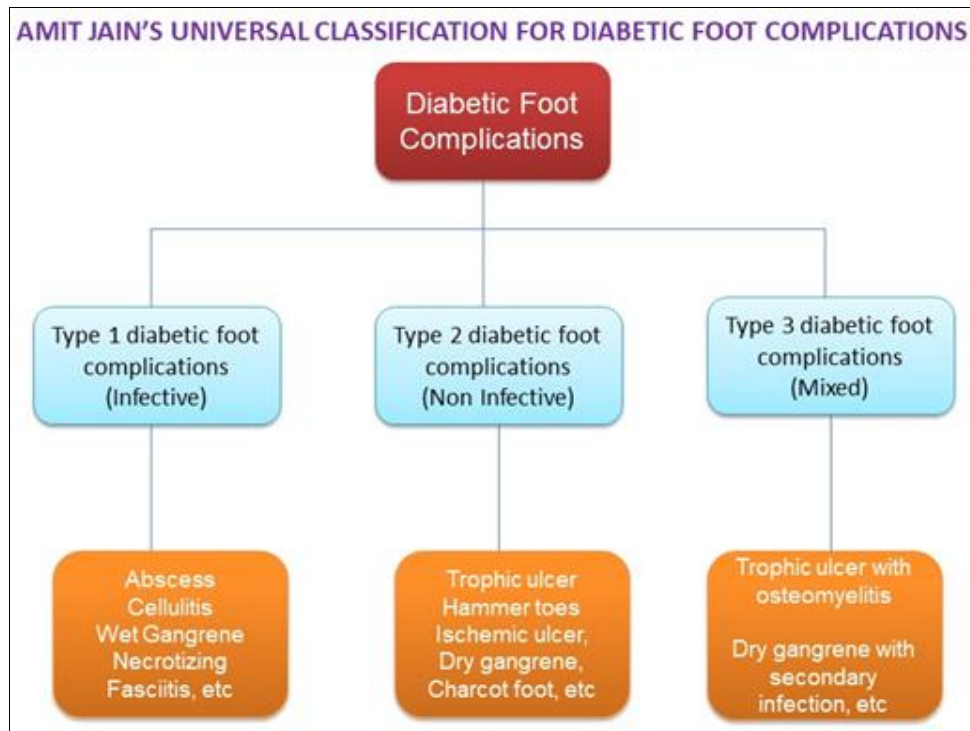


Fig 1: Showing Amit Jain’s universal classification for diabetic foot complications

Table 1: Showing Amit Jain’s scoring system for diabetic foot

S. No	Characteristics	Involvement of Foot			
		No Ulcer → 0	Forefoot Ulcer → 2	Midfoot Ulcer → 4	Hindfoot Ulcer/ Full Foot/Beyond → 6
1.	Presence of Ulcer	No Ulcer → 0	Forefoot Ulcer → 2	Midfoot Ulcer → 4	Hindfoot Ulcer/ Full Foot/Beyond → 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 Peripheral Arterial Disease → 0	Mild → 2	Moderate → 4	Severe → 8
6.	Charcot Foot/ Destroyed Joints	No → 0	Forefoot → 2	Midfoot → 4	Hindfoot/Whole Foot → 8
7.	Skin Necrosis	No → 0	Forefoot Necrosis → 2	Midfoot Necrosis → 4	Hindfoot Necrosis/Beyond → 8
8.	Surrounding Cellulitis	No → 0	Upto Forefoot → 2	Upto Midfoot → 4	Upto Hindfoot & Beyond → 6
9.	Past Amputation	No → 0	Toe Amputation → 2	Forefoot Amputation → 4	Midfoot Amputation → 6
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 Muscle 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	No → 0		Present → 2	
16.	Surgeon Factor	Podiatric/Diabetic Foot Surgeon → 0		Other Surgeons → 2	

**Methods and Material**

A prospective descriptive study was done in department of surgery at Rajarajeswari medical college, Bengaluru, India. It is a tertiary care teaching hospital that mainly caters patients

from rural area. The study period was from June 2018 to May 2019. An Institutional ethics committee clearance was obtained for this study (RRMCH-IEC/26/2017-18).

The following were the inclusion and exclusion criteria.

**Inclusion Criteria**

1. All the diabetic foot patients admitted and who underwent major amputation in department of surgery were included.

**Exclusion Criteria**

1. Patients operated outside
2. Patients operated in other departments
3. Patients discharged against medical advice

**Data Analysis** [13, 14, 15]

Data was analyzed using statistical software SPSS 22.0 and R environment ver.3.2.2. Microsoft word and excel were used to generate graphs and tables. Both descriptive and inferential statistics were carried out in the study. Results on continuous measurements were presented on Mean ±SD (Min-Max) and results on categorical measurements were presented in number (%). Significance was assessed at 5% level of significance.

The following assumption on data is made

- Dependent variables should be normally distributed,
- 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. 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 was used when samples were very small.

**Significant Figures**

- + Suggestive significance (P value: 0.05<P<0.10)
- \* Moderately significant (P value: 0.01<P 0.05)
- \*\* Strongly significant (P value: P≤0.01).

**Results**

A total of 15 patients were included in this study. 13 patients (86.75%) were males and 2 patients (13.3%) were females [Figure 2].

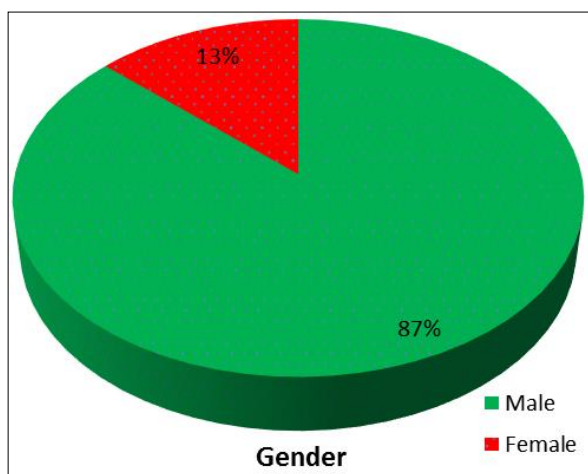


Fig 2: Showing gender distribution

86.7% of the patients were above 50 years of age [Table 2] and 66.65% of them had diabetes of less than 12 years [Table 3].

Table 2: Showing age distribution of patients studied

Age in years	Percentage %
<50	13.3
50-60	46.7
61-70	40
Total	100

Table 3: Showing Diabetes mellitus duration distribution of patients studied

Diabetes Duration	Percentage %
<6	33.3
6-12	33.3
12-24	26.7
>24	6.7
Total	100

9 patients (60%) had type 1 diabetic foot complications and 6 patients (40%) had type 3 diabetic foot complication [Table 4]. Abscess, necrotizing fasciitis and wet gangrene which are type 1 diabetic foot complications occurred in equal percentage.

Table 4: Showing type of diabetic foot complication and pathological lesion as per Amit Jain’s universal classification for diabetic foot complication

Type of diabetic foot complication	Pathology	Percentage %
Type 1 diabetic foot complication	Abscess	20
	Necrotizing fasciitis	20
	Wet gangrene	20
Type 3 diabetic foot complication	Infected ulcer	20
	Infected Charcot foot	13.3
	Infected dry gangrene	6.7
	Total	100

20 % of the patients who underwent major amputation had underlying osteomyelitis [Figure 3].

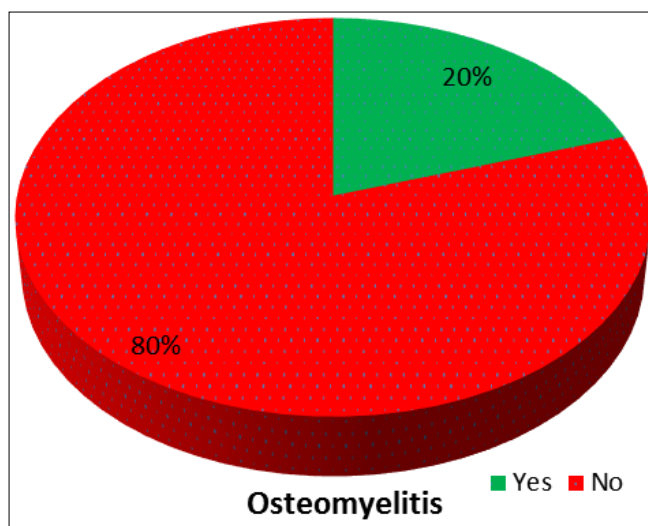


Fig 3: Showing osteomyelitis distribution

Below knee amputation was the most common major amputation (80%) in this series with below knee amputation and above knee amputation ration being 4:1 [Figure 4].

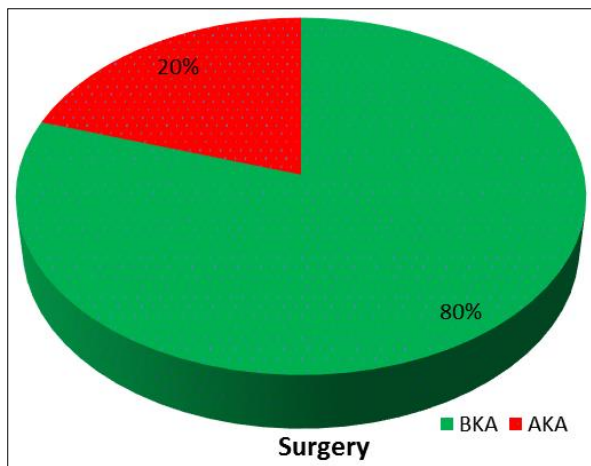


Fig 4: Showing distribution of major amputations

There was no relation between age, gender, diabetes mellitus duration, diagnosis, presence of osteomyelitis, peripheral vascular disease, side of foot involved, resurgeries or stump status with major amputation [Table 5, 6, 7].

Table 5: Showing association of clinical variables in relation to type of surgery of patients studied

Variables	Surgery		Total n=15)	P value
	BKA n=12)	AKA n=3)		
Age in years				
<50	16.7	0	13.3	0.723
50-60	50	33.3	46.7	
61-70	33.3	66.7	40	
Gender				
Male	83.3	100	86.7	1
Female	16.7	0	13.3	
Diabetes mellitus duration				
<6	33.3	33.3	33.3	1
6-12	33.3	33.3	33.3	
12-24	25	33.3	26.7	
>24	8.3	0	6.7	
Diagnosis				
Abscess	25	0	20	1
Infected ulcer	16.7	33.3	20	
Necrotizing fasciitis	16.7	33.3	20	
Wet gangrene	16.7	33.3	20	
Infected Charcot foot	16.7	0	13.3	
Infected dry gangrene	8.3	0	6.7	

Table 6: Showing association of clinical variables in relation to type of surgery of patients studied

Variables	Surgery		Total (n=15)	P value
	BKA n=12)	AKA n=3)		
Osteomyelitis				
Yes	16.7	33.3	20	0.516
No	83.3	66.7	80	
PVD				
Yes	8.3	0	6.7	1
No	91.7	100	93.3	
Side Foot				
Right	50	33.3	46.7	1
Left	50	66.7	53.3	
Stump [Closed /Open]				
Open	41.7	0	33.3	0.505
Closed	58.3	100	66.7	

Table 7: Showing association of Resurgeries in relation to type of surgery of patients studied

Resurgery	Surgery		Total	P Value
	BKA	AKA		
Yes	66.7	66.7	66.7	1.00
No	33.3	33.3	33.3	
Total	100	100	100	

There was also no relation of type of diabetic foot complication, risk categorization, hypertension, chronic kidney disease, ischemic heart disease, history of past amputation, stump complication, type of stump complication with major amputation [Table 8 and 9]. 73.4% of the patients with major amputation had a score of 16 and above [Figure 5]

Table 8: Association of clinical variables in relation to type of surgery of patients studied

Variables	Surgery		Total n=15)	P value
	BKA n=12)	AKA n=3)		
Type Diabetic Foot Complications				
Type I	58.3	66.7	60	1
Type II	0	0	0	
Type III	41.7	33.3	40	
Amit Jain's Scoring				
<15	33.3	0	26.7	0.516
>15	66.7	100	73.3	
Risk Category				
No risk (0-5)	0	0	0	0.859
Low risk (6-10)	0	0	0	
Moderate (11-15)	33.3	0	26.7	
High (16-20)	16.7	33.3	20	
Very high (21-25)	25	33.3	26.7	
Inevitable (26 & above)	25	33.3	26.7	
Hypertension				
Yes	33.3	33.3	33.3	1
No	66.7	66.7	66.7	
CKD				
Yes	16.7	33.3	20	0.516
No	83.3	66.7	80	
IHD				
Yes	0	0	0	1
No	100	100	100	



Fig 5: Showing patient who ended in below knee amputation. He was operated at another hospital for abscess foot. His final score was 16 [Ulcer 6 + Gangrene 2 + Pus 6 + Surgeon factor 2] and he belonged to high risk category.

**Table 9:** Showing association of clinical variables in relation to type of surgery of patients studied

Variables	Surgery		Total n=15)	P value
	BKA n=12)	AKA n=3)		
Past Amputation				
Yes	25	33.3	26.7	1
No	75	66.7	73.3	
Stump Complications				
Yes	66.7	66.7	66.7	1
No	33.3	33.3	33.3	
Stump Type				
Abscess	58.3	33.3	53.3	0.525
Flap necrosis	0	33.3	6.7	
Wound dehiscence	8.3	0	6.7	
Haemorrhage	8.3	0	6.7	
No complication	25	33.3	26.7	
Infective/Non-Infective				
Infective	66.7	66.7	66.7	1
Non infective	33.3	33.3	33.3	

There was also no correlation between stump status and type of stump complication with peripheral vascular disease [Table 10].

**Table 10:** Showing association of clinical variables in relation to peripheral vascular disease of patients studied

Variables	PVD		Total n=15)	P value
	Yes n=1)	No n=14)		
Stump Complications				
Yes	100	64.3	66.7	1
No	0	35.7	33.3	
Stump [Closed/ Open]				
Open	100	28.6	33.3	0.333
Closed	0	71.4	66.7	
Stump Type				
Abscess	100	50	53.3	1
Flap necrosis	0	7.1	6.7	
Wound dehiscence	0	7.1	6.7	
No complication	0	28.6	26.7	
Haemorrhage	0	7.1	6.7	
Infective/Non-Infective				
Infective	100	64.3	66.7	1
Non infective	0	35.7	33.3	

The type of diabetic foot complication was significantly associated with stump status. Around 80% of type 3 diabetic foot complications had open stump whereas 80% of type 1

diabetic foot complications had closed stump (P-0.089+). There was no relation of type of diabetic foot complication with type of stump complication. There is also no association between risk categorization, re-surgeries, type of stump complication with stump status [Table 11].

**Table 11:** Showing association of clinical variables in relation to Stump being Closed/Open of patients studied

Variables	Stump [Closed/Open]		Total (n=15)	P value
	Open n=5)	Closed n=10)		
Amit Jain's Scoring				
<15	20	30	26.7	1
>15	80	70	73.3	
Risk Category				
No risk	0	0	0	1
Low risk	0	0	0	
Moderate	20	30	26.7	
High	20	20	20	
Very high	40	20	26.7	
Inevitable	20	30	26.7	
Type Diabetic Foot Complications				
Type I	20	80	60	0.089+
Type II	0	0	0	
Type III	80	20	40	
Resurgeries				
Yes	100	50	66.7	0.101
No	0	50	33.3	
Stump Complications				
Yes	80	60	66.7	0.6
No	20	40	33.3	
Stump Type				
Abscess	100	30	53.3	0.184
Flap necrosis	0	10	6.7	
Wound dehiscence	0	10	6.7	
Haemorrhage	0	10	6.7	
No complication	0	40	26.7	
Infective/Non-Infective				
Infective 1	100	50	66.7	0.101
Non infective	0	50	33.3	

All the patients who had score of more than 15 (High risk and above) had significant association [Figure 6] with stump complications (P-0.077+) and they were infective. Although no association existed between score with stump status, type of major amputation, type of diabetic foot complication or resurgeries in this series [Table 12].

**Table 12:** Showing association of study variables in relation to Amit Jain's scoring of patients studied

Variables	Amit Jain Scoring (>15)		Total (n=15)	P value
	Yes n=4)	No n=11)		
Stump Complications				
Yes	25	81.8	66.7	0.077+
No	75	18.2	33.3	
Stump Type				
Abscess	25	63.6	53.3	0.292
Flap necrosis	0	9.1	6.7	
Wound dehiscence	0	9.1	6.7	
No complication	50	18.2	26.7	
Haemorrhage	25	0	6.7	
Infective/Non-Infective				
Infective	25	81.8	66.7	0.077+
Non infective	75	18.2	33.3	
Stump [Closed /Open]				

Open	25	36.4	33.3	1
Closed	75	63.6	66.7	
Type of Diabetic Foot Complications				
Type I	75	54.5	60	0.604
Type II	0	0	0	
Type III	25	45.5	40	
Surgery				
BKA	100	72.7	80	0.516
AKA	0	27.3	20	
Resurgeries				
Yes	50	72.7	66.7	0.56
No	50	27.3	33.3	

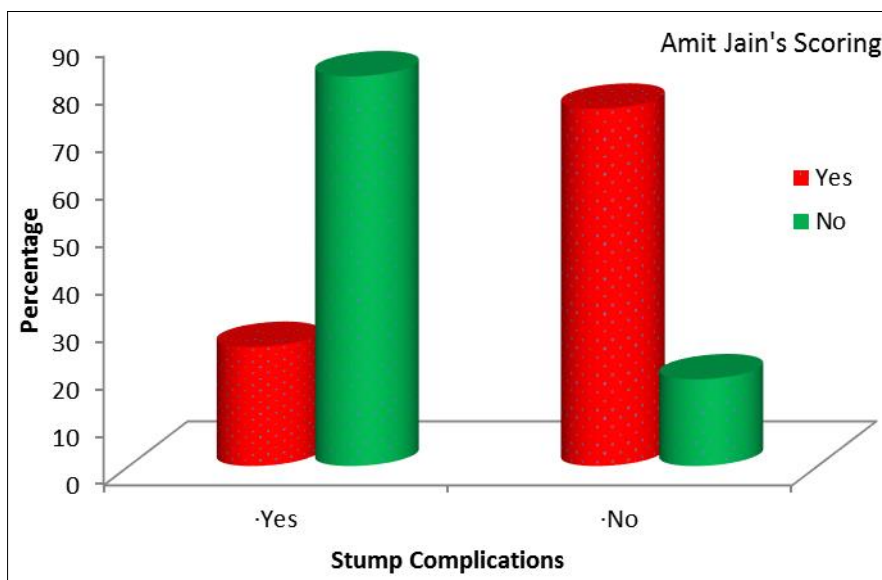


Fig 6: Showing the distribution of the stump complication in relation to Amit Jain's scoring system

**Discussion**

Although many consider amputations to be mutilating surgery, there are others who consider it to be a reconstruction as it is a step towards rehabilitation [16]. Around 85% of all amputation were preceded by ulcers and 58% of the ulcers were likely to get infected [17, 18]. Diabetic foot infections have 150-fold increased risk of amputation in lower limb in diabetic patients [18]. Recent studies done by Jain *et al.* found the major amputations in diabetic foot in major teaching hospitals to be between 16% to 20% [19, 20].

Major amputation in diabetes patient is associated with significant social, economic and psychological impact on patients and their families along with decreased survival [21, 22]. Further, major amputations have stump complications that increases morbidity, prolonged hospitalization and cost of treatment.

Some of the well-known post-operative complication which are acute in nature are wound infections, wound dehiscence, hematoma, phantom pain. Stump gangrene, flap necrosis, etc [2, 9, 23, 24]. In Chalya *et al.* series [2], the stump complication was 33.3% whereas in Ajibade *et al.* series, it was 31% [9]. In Jain *et al.* series done exclusively on stump complications [9], it was around 43.7% wherein 78.57% of stump complication occurring after major amputation where in type 1 diabetic foot complication with diabetic foot abscess being the commonest cause for which amputation was done.

In this series of stump complication, 60% of patients who underwent major amputation were operated for type 1 diabetic foot complications with abscess, necrotizing fasciitis and wet gangrene being common in equal proportion with 66.7% of them having some form of postoperative stump complication. In Chalya *et al.* series [2], 21% of them had wound infection of

stump and 3.1% had wound dehiscence. In Umaru *et al.* series, 28.3% had wound infection and 12.3% had wound dehiscence [22]. In Salawu *et al.* series [25], 10.7% had wound infection and 6.4% had flap necrosis after major amputation of extremities. In Jain *et al.* series [9] that studied stump complications in major amputation, 64.29% of the patients had wound infection and it was commonest complication among stump complication followed by flap necrosis [14.28%]. In this series, 53.3% of stump had wound infection [Figure 7] and 6.7% had flap necrosis, wound dehiscence and hemorrhage each.



Fig 7: Showing stump infection after below knee amputation. Note the pus discharge.

In Jain *et al.* series <sup>[9]</sup>, 85.7% of all the stump complication had score of 16 and above. Around 35.71% of them were in high risk category and Amputation inevitable category as per Amit Jain's scoring system. In this series, 66.7% had stump complications and these complications were statistically significant in patients with score of 16 and above in this series. In Jain *et al.* series <sup>[9]</sup>, 14.29% of patient with stump complications had in hospital mortality. In our series, there was no inpatient mortality.

### Conclusion

Major amputation is a distressing procedure with significant morbidity. Below knee amputations are the most common type of major amputations in diabetic foot and type 1 diabetic foot complication accounted for 60% of major amputation. 66.7% of patients with major amputation had postoperative stump complication with stump infection being most common. Majority of the type 1 diabetic foot complications had their stump being closed at surgery whereas the patients with type 3 diabetic foot complications had their stump left open and it was statistically significant. Patients with Amit Jain's score of 16 and above had significant stump complications and most of them were of infective type.

### Acknowledgement

The author would like to thank Dr KP Suresh, Scientist (Biostatistics), National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Bangalore, for reviewing the research methodology and statistical results of the study.

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