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EARLY VERSUS LATE WOUND DEBRIDEMENT IN THE MANAGEMENT OF DIABETIC FOOT ULCERS AT A TERTIARY CARE TEACHING HOSPITAL IN SOUTH INDIA: A RETROSPECTIVE COMPARATIVE COHORT STUDY

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ABSTRACT

Background: Diabetic foot ulcers (DFUs) are a major source of morbidity in patients with diabetes, and surgical debridement of infected or necrotic tissue is a cornerstone of their management. While the principle of source control is well established, the effect of debridement timing — early versus late — on clinical outcomes has been little studied in Indian tertiary care settings. This study compared outcomes between patients undergoing early (within 48 hours of admission) and late (after 48 hours) surgical debridement for infected DFUs.

Methods: We conducted a retrospective comparative cohort study of 100 patients admitted with infected diabetic foot ulcers at a tertiary care teaching hospital in Chennai, Tamil Nadu, India, between January 2023 and January 2025. Patients were divided into an early debridement group (Group A, n=50) and a late debridement group (Group B, n=50). Adults over 18 years with type 2 diabetes and clinical and/or radiological evidence of infected foot ulcer who received surgical debridement during hospitalisation were included. Descriptive statistics, the chi-square test, independent t-test, and multivariate logistic regression were used for analysis (SPSS v25; $p<0.05$ considered significant).

Results: The cohort had a mean age of 60.4 ± 10.2 years (65% male) and mean diabetes duration of 8.7 ± 4.1 years; comorbidities included hypertension (52%), coronary artery disease (14%), and chronic kidney disease (10%). All ulcers were Wagner grade 2 or higher. Compared with Group B, Group A had a shorter mean hospital stay (7.2 ± 2.1 vs 10.5 ± 3.4 days; reduction of 3.3 days, $p<0.001$), a lower post-debridement infection rate (18% vs 34%), a higher healing rate (84% vs 66%, $p=0.01$), and a lower treatment failure rate (10% vs 20%). Early debridement independently predicted healing success on multivariate logistic regression (odds ratio 2.8; 95% confidence interval 1.4–5.7; $p=0.004$), and the amputation rate was significantly lower in Group A ($p=0.02$).

Conclusion: In this cohort, early surgical debridement (within 48 hours of admission) of infected diabetic foot ulcers was associated with improved healing, reduced treatment failure and amputation, and shorter hospital stay compared with late debridement. These findings support prioritising prompt surgical source control in diabetic foot infection, pending confirmation in larger prospective multicentre studies.

KEYWORDS: Diabetic foot ulcer; wound debridement; surgical timing; amputation; retrospective cohort study; tertiary care; India

INTRODUCTION

Diabetic foot ulcers (DFUs) are among the most serious and costly complications of diabetes mellitus, with an estimated lifetime risk of 15–25% among people with diabetes, and they remain a leading cause of hospital admission, prolonged inpatient stay, and lower-extremity amputation [1,2]. Infected or non-healing ulcers are particularly high-risk, and international guidance identifies prompt and adequate surgical source control as a central pillar of managing moderate-to-severe diabetic foot infection [1].

Surgical debridement — the removal of devitalised, necrotic, and infected tissue — is considered a cornerstone of diabetic foot ulcer management. Mechanistically, debridement is thought to convert a chronic, biologically ‘stalled’ wound into an acute one by removing senescent cells, biofilm, and necrotic debris, thereby reducing bacterial and inflammatory burden and allowing the normal sequence of wound healing — the basis of the widely used ‘wound bed preparation’ framework — to resume [3].

Although debridement itself is routinely practised, the optimal timing of surgery — early versus delayed — remains comparatively understudied, particularly in Indian tertiary care settings. In a retrospective series of 106 patients with diabetic foot deep space abscess, each additional day of delay before debridement independently increased the likelihood of a more proximal amputation level, and amputation level was significantly more proximal among patients whose surgery was delayed after inter-hospital transfer [4]. Current international guidelines likewise recommend urgent surgical intervention for diabetic foot infections associated with abscess, deep tissue involvement, or necrosis, reflecting the

presumption that delay allows infection and tissue loss to progress [1]. However, contemporary, India-specific comparative data quantifying the effect of debridement timing on healing, amputation, and length of stay remain limited. This study aims to retrospectively compare the demographic profile and clinical outcomes — healing rate, treatment failure, amputation, hospital stay, and post-debridement infection — of patients undergoing early (within 48 hours of admission) versus late (after 48 hours) surgical debridement for infected diabetic foot ulcers at a tertiary care teaching hospital in South India.

2. METHODS

2.1 Study Design

This was a retrospective comparative cohort study.

2.2 Setting and Study Period

The study was conducted in the Department of General Surgery of a tertiary care teaching hospital in Chennai, Tamil Nadu, India, and covered admissions between January 2023 and January 2025.

2.3 Study Population and Group Classification

The study population comprised 100 patients admitted with infected diabetic foot ulcers. Patients were classified into two groups based on the timing of their first surgical debridement: the Early Debridement Group (Group A, n=50), who underwent debridement within 48 hours of admission, and the Late Debridement Group (Group B, n=50), who underwent debridement more than 48 hours after admission.

2.4 Inclusion Criteria

Adults over 18 years of age with type 2 diabetes mellitus, with clinical and/or radiological evidence of an infected foot ulcer, who received surgical debridement during hospitalisation, were included.

2.5 Ulcer Severity Assessment

Ulcer severity was graded using the Wagner classification system, summarised in Table 1.

Table 1. Wagner classification of diabetic foot ulcers.

Wagner Grade	Description
0	No ulcer in a high-risk foot
1	Superficial ulcer, full skin thickness, no deeper involvement
2	Deeper ulcer to ligament/muscle; no bone involvement or abscess
3	Deep ulcer with cellulitis or abscess, often with osteomyelitis
4	Localised gangrene (e.g., toe, forefoot)
5	Extensive gangrene involving the whole foot

2.6 Data Collection

Data were extracted from hospital records, including demographics, comorbidities, ulcer characteristics, microbial isolates, timing and type of surgical debridement, and clinical outcomes.

2.7 Outcome Measures

The primary outcomes were healing rate and amputation rate. Secondary outcomes were treatment failure, mean hospital stay, and post-debridement infection rate.

2.8 Statistical Analysis

Descriptive statistics were used to summarise demographic and clinical characteristics. Continuous variables were expressed as mean ± standard deviation and compared using the independent-samples t-test; categorical variables were expressed as frequencies and percentages and compared using the chi-square test. Multivariate logistic regression was used to assess whether debridement timing independently predicted healing success. Analyses were performed using SPSS version 25 (IBM Corp.), with $p<0.05$ considered statistically significant.

3. RESULTS

3.1 Patient Demographics

The cohort had a mean age of 60.4 ± 10.2 years, with 65% male and 35% female patients. The mean duration of diabetes was 8.7 ± 4.1 years. The most common comorbidities were hypertension (52%), coronary artery disease (14%), and chronic kidney disease (10%).

Characteristic	Value
Total patients	100 (50 per group)
Mean age (± SD), years	60.4 ± 10.2
Male, %	65%
Female, %	35%
Mean duration of diabetes (± SD), years	8.7 ± 4.1
Hypertension, %	52%
Coronary artery disease, %	14%
Chronic kidney disease, %	10%

3.2 Ulcer Characteristics and Microbiology
All ulcers were Wagner grade 2 or higher. The most common pathogens isolated were Staphylococcus aureus (40%), Pseudomonas aeruginosa (25%), anaerobes (10%), and mixed flora (25%)

3.3 Treatment Outcomes by Group
Group A (early debridement) had a significantly shorter mean hospital stay and a lower post-debridement infection rate than Group B (late debridement), and showed higher healing and lower treatment-failure rates (Table 3).

Outcome	Group A – Early (n=50)	Group B – Late (n=50)
Mean hospital stay, days (± SD)	7.2 ± 2.1	10.5 ± 3.4
Post-debridement infection, %	18%	34%
Healing rate, %*	84%	66%
Treatment failure, %*	10%	20%

Table 3. Outcomes by debridement timing. *Healing-rate and treatment-failure percentages were not tabulated as raw figures in the source study materials; they were derived from the study's own plotted outcome chart (axis-calibrated reading) rather than newly generated, and should be verified by the authors against the primary dataset before submission.

3.4 Amputation
The amputation rate was significantly lower in Group A than in Group B (p=0.02). Of the total amputations recorded across the cohort, approximately 33% occurred in Group A and 67% in Group B, based on the distribution reported in the source study materials.

3.5 Predictors of Healing
On multivariate logistic regression, early debridement independently predicted healing success (odds ratio 2.8; 95% confidence interval 1.4–5.7; p=0.004). [Authors: please specify which other covariates (e.g., age, HbA1c, comorbidities, Wagner grade, peripheral arterial disease) were included in the regression model, as this was not detailed in the source material.]

4. DISCUSSION
4.1 Interpretation of Results
In this cohort, early surgical debridement, performed within 48 hours of admission, was associated with a substantially higher healing rate, lower treatment failure, lower amputation rate, shorter hospital stay, and fewer post-debridement infections than debridement delayed beyond 48 hours. These findings are consistent with the broader literature linking delayed surgical source control to worse outcomes in diabetic foot infection. In a retrospective series of 106 patients with diabetic foot deep space abscess, delay before debridement was independently associated with a more proximal amputation level on multivariate analysis, and amputation level was significantly more proximal among patients transferred from other hospitals after a mean delay of over six days without debridement [4]. Current international guidance similarly recommends urgent surgical intervention for diabetic foot infections involving abscess, deep tissue extension, or necrotising infection, reflecting the same underlying rationale [1].
Mechanistically, the benefit of early debridement is consistent with the principles of wound bed preparation, in which removal of necrotic tissue, biofilm, and non-viable debris is thought to reduce bacterial and inflammatory burden and allow a chronic, biologically stalled wound to re-enter a normal healing trajectory [3]. Delayed debridement may permit

ongoing bacterial proliferation and tissue necrosis, plausibly explaining the higher post-debridement infection rate and lower healing rate observed in Group B in this cohort.

4.2 Comparison with Regional and International Evidence

Contemporary Indian guidance on diabetic foot disease emphasises prompt, multidisciplinary assessment and timely surgical referral as central to limb preservation, but detailed local evidence quantifying the effect of debridement timing on hard outcomes such as amputation and healing has been limited [5,6]. The findings of this study add to this evidence base and suggest that delays beyond 48 hours, whether due to diagnostic delay, inter-departmental referral, or resource constraints, may carry a measurable clinical cost in an Indian tertiary care setting. Peripheral arterial disease is a recognised modifier of diabetic foot ulcer prognosis and can independently delay healing regardless of debridement timing [7]; the extent to which vascular status differed between the two groups in this cohort was not reported in the source material and should be examined in future analyses.

4.3 Strengths and Limitations

Strengths of this study include a reasonably sized comparative cohort (n=100) with clearly defined, clinically meaningful groups and multivariate adjustment for the association between debridement timing and healing. Limitations include its retrospective, single-centre design, which may limit generalisability, and the approximately 25-month study window, which may not fully account for secular changes in practice. Several data points required for a complete account of the cohort were not available in the source material and should be confirmed by the authors before submission: the covariates included in the logistic regression model; whether baseline demographic and comorbidity characteristics were balanced between groups; the identity of the remaining approximately 7% of microbial isolates; and the absolute (rather than relative) amputation rate within each group of 50 patients. The healing-rate and treatment-failure percentages reported in Table 3 were reconstructed from the study's own plotted outcome data rather than from a tabulated source and should likewise be verified against the primary dataset.

4.4 Implications for Practice

These findings support prioritising early surgical assessment and debridement, within 48 hours of admission where feasible, as part of the initial management of infected diabetic foot ulcers, consistent with international recommendations for urgent source control in moderate-to-severe diabetic foot infection [1]. Institutional pathways that reduce time from admission to surgical review, such as dedicated diabetic foot or multidisciplinary limb-salvage services, may help translate this association into practice, though prospective confirmation is needed before firm causal conclusions can be drawn.

5. CONCLUSION

In this retrospective cohort from a tertiary care teaching hospital in South India, early surgical debridement of infected diabetic foot ulcers, within 48 hours of admission, was associated with improved healing, reduced treatment failure and amputation, and shorter hospital stay compared with debridement delayed beyond 48 hours. The timing of debridement appears to be a clinically important and potentially modifiable factor in diabetic foot ulcer management. These findings support timely surgical source control as a priority in institutional diabetic foot care pathways, pending confirmation in larger prospective, multicentre studies.

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Conflicts of Interest: The authors declare no conflicts of interest.

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