

## Hand infection in patients with diabetes: a series of 17 cases and a pooled analysis of the literature

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**Background/aim:** The aim of this study was to report the clinical characteristics and the treatment outcomes of hand infections in diabetic patients and to review the literature.

**Materials and methods:** The medical records of 17 patients with diabetic hand infections admitted to the Diabetic Foot Care Center of two different clinics from January 2012 to October 2017 were reviewed. To perform the pooled analysis, published series (32 studies) were searched in two international databases (www.scopus.com and www.pubmed.com).

**Results:** Of the 17 patients (mean age  $61.7 \pm 8.5$  years), 8 (47.1%) were female. All cases were type 2 diabetes mellitus. The mean duration of diabetes was  $9.0 \pm 5.96$  years and the mean HbA1c was  $7.86 \pm 1.88\%$ . There was necrosis in 8 patients (47.1%). The most common causes were injury during saw and hammer use in 5 patients (29.4%) and injury due to inappropriate nail cutting in 3 patients (17.6%). Nine (52.9%) patients were operated on. No patients underwent any major amputations or died. In 32 publications, 704 patients with diabetic hand infections were found. The average age was 53.43 years ( $n = 591$ ) and 84.29% of patients (322/382) were found to have type 2 DM. The mean duration of diabetes was 4.12 years ( $n = 317$ ) and the mean HbA1c was 10.58% ( $n = 140$ ). The rate of surgical operation was 74.59% (323/433).

**Conclusion:** Diabetic hand injuries often occur when using hand tools such as hammers, saws, and knives, and when cutting nails. It is necessary to use conservative treatment rather than amputation. These patients should consult experienced health care professionals.

**Key words:** Amputation, diabetes, diabetic hand infection, tropical diabetic hand

### 1. Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder that affects many physiological systems in the body (1). Uncontrolled or poorly controlled DM is a risk factor for the development of infection (2). DM is a known systemic disease associated with increased incidence of morbidity and mortality. The treatment period of ulcers is long and poor treatment can lead to extremity amputations (3). Because of the amputation and mortality rate, diabetic foot receives more attention as a severe complication related to DM. However, diabetic hand is underrated and usually neglected by clinicians. In fact, diabetic hand has not been considered a specific complication of DM and no precise definition can be found in the literature (1,4–6).

The first paper related to hand ulcer with infection in diabetic patients was published in the USA in 1977 (7). However, the majority of studies are from African

countries. A definition found in the literature is diabetic hand syndrome and it is associated with the musculoskeletal problems of diabetic hand. Although musculoskeletal manifestations such as limited joint mobility, Dupuytren's contracture, and trigger fingers are the most commonly published conditions of diabetic hand, hand ulcer with infection can cause even more serious complications such as gangrene, amputation of an extremity, or even death of the patient (8,9). In the literature, there are many independent risk factors for developing diabetic hand syndrome such as peripheral neuropathy, poorly or uncontrolled diabetes, female sex, insect bites, hand trauma, low socioeconomic status, residence in coastal areas, and late administration to hospital (6,10,11).

There are also only a few studies related to the hand problems of diabetic patients in this country. In the present study, we aimed to report the clinical characteristics and

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the treatment outcomes of 17 patients with diabetic hand infection followed up in two centers from January 2012 to October 2017 and to review the literature.

## 2. Materials and methods

We reviewed the medical records of diabetic inpatients with the diagnosis of diabetic hand infection admitted to the Diabetic Foot Care Center of two clinics from January 2012 to October 2017. Detailed hospital records of these patients were retrieved. The available information was age, sex, symptoms, duration of diabetes, the presence of osteomyelitis, tissue culture, microbiological data, hemoglobin A1C (HbA1c) levels, the cause of trauma, wound localization, antibiotic therapy, surgical treatment, total hospitalization time, and presence of comorbid diseases. Various significance analyses of these data were performed by comparison.

### 2.1. Review and analysis of literature

Published series were searched in two international databases (www.scopus.com and www.pubmed.com) to perform the pooled analysis. Key words used for Scopus and PubMed were (hand OR upper limb OR upper extremity) AND (diabetes OR diabetic) AND (infected OR infection OR ulcer). All documents found in the databases were analyzed by separate investigators. The following articles were excluded:

1. Those written in languages other than English
2. Those with unavailable full text
3. Those where age, sex, duration of ulcer, and ulcer characteristics for all patients with diabetic hand infection were not clearly distinguishable
4. Those with duplications in PubMed and Scopus
5. One of the two separate studies in the same center with overlapping periods.

In the study, the numerical information found for all data was given in proportion to the total number of patients whose data were available. A total of 32 studies were included in the analysis (1,5–7,10–36).

## 3. Results

### 3.1. Results of the patients

Seventeen patients with the diagnosis of diabetic hand infection were admitted to the Diabetic Foot Care Center of two clinics from January 2012 to October 2017. Of the 17 patients (mean age  $61.7 \pm 8.5$  years; range 45–80 years), 8 (47.1%) were female. All cases were type 2 diabetes mellitus. The average known duration of diabetes was  $9.0 \pm 5.96$  years (range 0–25 years) and the mean HbA1c was  $7.86 \pm 1.88\%$  (range 6.0%–11.6%). Only one patient was not aware of his diabetes before the onset of the hand infection. Clinical data of the patients are presented in the Table. Osteomyelitis of the affected hand was detected in 8 (47.1%) patients. There was necrosis in 8 (47.1%) patients and abscess in 10 (58.8%).

Three (17.6%) patients had an infection in both hands and the number of patients with concurrent diabetic foot infection was 4 (23.52%). Fifteen (88.3%) of the patients had a comorbid disease. The two most common causes of ulcer and infection etiology in our patients were injuries during blade, saw, and hammer use in 5 (29.4%) cases and injuries due to inappropriate nail cutting in 3 cases (17.6%). In 2 of 14 cases (14.29%), causative agents were detected in tissue culture. *Acinetobacter baumannii* and *Candida albicans* were detected as a polymicrobial agent in one case and *Pseudomonas fluorescens* in the other case.

Nine (52.9%) patients were operated on. In 5 (29.4%) cases, disarticulation or amputation was performed during the surgery. Antimicrobials used in the treatment are given in the Table. In all patients, there was a bacterial diabetic hand infection. There was also an invasive fungal diabetic hand infection in one patient. The median duration of antibiotic treatment was  $34.76 \pm 19.81$  days (range 14–61 days). No major amputations were performed and no deaths occurred in any patient.

### 3.2. Results of pooled analysis

In 32 publications, 704 patients with diabetic hand infection were found. The number of the patients with sex data was 663 and 281 (42.38 %) of them were female. The average age was 53.43 years ( $n = 591$ ). The proportion of the patients diagnosed with diabetes after admission was 9.38% (32/341). After diagnosis of diabetes, 84.29% of patients (322/382) were found to have type 2 DM. The mean duration of diabetes was 4.12 years ( $n = 317$ ) and the mean HbA1c was 10.58% ( $n = 140$ ). The rate of late admission was 96.97% (128/132) and the mean time for admission was 1.38 weeks (128/132). The number of patients according to the side of the wound in their hands was 136 (55.06%) right side, 113 (45.75%) left side, and 2 (0.81%) bilateral.

The positive culture result rate was 85.93% (397/462) and 27.15% of them (138/512) were polymicrobial. *Staphylococcus aureus* was detected in 33.41% (138/413) of patients and in 7.83% of patients a fungal agent was detected (18/230).

Gangrene was detected in 51 (13.75%) cases ( $n = 371$ ). Paronychia was found in 16% (48/300) and the superficial infection and/or cellulitis detection rate was 28.07% (119/424). The osteomyelitis rate was 28.40% (73/257) and the abscess rate was 38.10% (197/517). The necrotizing fasciitis rate was 15.92% (39/245).

The mean hospital stay was 16.23 days ( $n = 388$ ). The rate of surgical operation was 74.59% (323/433) and the debridement and/or drainage rate was 57.36% (226/394). The rate of amputation surgery was 22.93% (161/702).

Retinopathy was found in 45.46% (40/88) of the examined cases. The proportion of patients with nephropathy and/or end-stage renal disease and/or dialysis

**Table.** Clinical features of the patients.

No.	Sex	Age (years)	DM (years)	HbA1c (%)	Location	Ulcer properties	Comorbidities	Surgical procedures	Duration of the medical therapy (days)
1	F	54	3	11.5	Right	osteomyelitis, necrosis, abscess	-	finger amputation, drainage	Fluconazole+meropenem+daptomycin
2	F	56	8	7.2	Right	osteomyelitis, necrosis	-	spontaneous recovery	Ampicillin/sulbactam+ciprofloxacin
3	F	61	10	6	BHU, DFU	necrosis	RA	spontaneous recovery	Tigecycline
4	M	63	7	7.4	Right	edema, erythema	-	-	Amoxicillin/clavulanate+fusidic acid
5	F	58	5	6.3	Left	osteomyelitis	-	debridement, arthrodesis	Ampicillin/sulbactam
6	M	70	25	6.5	Right, DFU	abscess	CRF, PAD, CAD	spontaneous recovery	Amoxicillin/clavulanate
7	M	66	15	6.7	BHU	osteomyelitis, necrosis, abscess	-	finger amputation	Amoxicillin/clavulanate+ciprofloxacin
8	F	54	3	11.6	Right	necrosis	-	finger amputation	Ertapenem
9	M	64	6	8.4	Left	abscess	-	spontaneous recovery	Moxifloxacin
10	M	63	0*	6.7	Left	abscess	-	debridement, drainage	Piperacilin/tazobactam+daptomycin
11	F	75	10	8.2	Left	necrosis, abscess	-	spontaneous recovery	Ampicillin/sulbactam
12	F	80	14	6.1	Left	osteomyelitis, necrosis	CRF	distal phalanks amputation	Ampicillin/sulbactam
13	M	64	9	7.2	Right	osteomyelitis, abscess	CRF, CHF	regional debridement, drainage	Moxifloxacin
14	M	52	10	7.1	BHU, DFU	osteomyelitis, necrosis, abscess	CRF, PAD, CHF	distal phalanks amputation, drainage	Meropenem+daptomycin
15	M	45	3	11.4	Right, DFU	edema, erythema	-	-	Amoxicillin/clavulanate
16	F	62	14	8.3	Left	abscess	-	debridement drainage	Amoxicillin/clavulanate
17	M	62	11	6.9	Left	osteomyelitis, abscess	-	debridement drainage, internal fixator	Ampicillin/sulbactam

\*Newly diagnosed diabetes, BHU bilaterally hand ulcer, DFU diabetic foot ulcer, CRF chronic renal failure, PAD peripheral artery disease, CAD coronary artery disease, CHF congestive heart failure, RA rheumatoid arthritis, F female, M male

was 28.57% (40/140). Of the 209 patients who were fully followed-up in the process, 86 (41.15%) recovered without loss of function. As for mortality, 7.82% of the patients died (18/230).

#### 4. Discussion

Diabetic hand infections in diabetic patients are as serious as diabetic foot ulcers but so far only a few studies related to diabetic hand ulcers have been published in the literature, because hand infections in diabetic patients are observed less frequently than foot infections, plus hand complications of diabetes mellitus are rare compared to foot complications, occurring at a rate of 1/20 (37–39). The majority of reports related to hand infections in diabetes are from developing countries in the tropical world and it is defined as diabetic hand syndrome with musculoskeletal manifestations such as limited joint mobility, Dupuytren's contracture, and trigger fingers (10,11,13–15,17,19,21,24,31,37,40,41). Diabetes and related complications are common in Turkey but only three studies about hand complications related to diabetes from this country were found in the literature (2,6,20). In our study, we report these 17 patients with diabetic hand infections.

In most of the published reports related to tropical hand syndrome in developing countries in the tropical world, the majority of the subjects were female (11,14,19,40,41). This is linked to the responsibility of women for farming and planting crops in rural areas in Africa (40,41). Reviewing the literature, we found male dominance overall in subject ratio. We also found male (52.9%) dominance in our study since acute occupational hand injuries are more common in males in this country (42). In addition, the male sex is more common among diabetic foot cases (43). This situation was also found to be high in favor of men in the pool analysis.

Diabetes mellitus is a multisystemic disease that affects multiple organs and causes complications. A long duration of poor blood glucose regulation can cause infection and poor wound healing in many ways: repressing cellular immunity, causing microangiopathy, and preventing chemotaxis and phagocytosis (9,38,41,44). In our review of the literature, we found the mean age of patients as 53.43 years, mean duration of diabetes as 4.12 years, and mean HbA1c as 10.58%. Similar to the findings in the literature, a relatively long duration of diabetes (mean 9 years) and poorly controlled glucose (mean HbA1c was 7.2%) in elderly patients (mean age  $61.7 \pm 8.5$  years) was also found to contribute to hand ulcer in our study. In the literature, after diagnosis of diabetes, 84.29% of patients were found to have type 2 DM. In our study, all cases were type 2 DM.

As mentioned in the literature, the admission time to hospital was another predisposing factor for treatment.

Late admission to hospital reduced the success of the treatment (10,13,20,21,27,36). The rate of late admission was 96.97% and the mean time for admission was 1.38 weeks in our review of the literature.

The rate of the patients diagnosed with diabetes after admission was 9.38% (32/341). In our study, one patient was not aware of his diabetes before the onset of the hand infection.

Diabetic hand management should be fast and aggressive. Furthermore, hand elevation, optimal glycemic control, aggressive intravenous antibiotics, early and adequate surgical incision and drainage of pus, debridement of necrotic tissue, and in some cases prompt amputation must be performed if indicated (40,41). In a study where the rate of amputation was 39%, the increased rate of amputation was attributed to deep tissue infection, renal failure, and polymicrobial infections (27). Fancel et al. presented a series of 41 diabetic patients and revealed that even the renal transplant recipients were at increased risk for amputation and that the amputation rate in these cases is 100% (12). On the other hand, multiple debridement and an aggressive approach to diabetic hand in diabetic patients decrease the incidence of amputation (5). In our study, 9 (52.9%) patients were operated on. In 5 (29.4%) patients, disarticulation or amputation was performed during the surgery. For the other 4 patients, only surgical debridement was performed, and the ulcer healed spontaneously without any reconstructive procedure for skin cover or bone stability. In our review of the literature, the rate of surgical operation was 74.59% and the debridement and/or drainage rate was 57.36%. The rate of patients undergoing amputation surgery was 22.93%. When compared to the literature, the rate of amputation in our study was moderate to high since the patients presented to the two tertiary referral hospitals, which were Diabetic Foot Care Centers included in our study. The patients included in this study had end-stage diabetic hand infections.

In diabetic hand, the most common presentation is the abscess formation; however, in some cases, cellulitis and ulceration can be found during administration (28). In our study, there was necrosis in 8 (47.1%) patients and abscesses in 10 (58.8%). Moreover, osteomyelitis of the affected hand was detected in 8 (41.1%) patients. No patient ended up with necrotizing fasciitis. In our review of the literature, there were 51 (13.75%) patients with gangrene ( $n = 371$ ). Paronychia was detected in 16% (48/300) and the superficial infection and/or cellulitis detection rate was 28.07% (119/424). The osteomyelitis rate was 28.40% (73/257) and the abscess rate was 38.10% (197/517). The necrotizing fasciitis rate was 15.92% (39/245).

In the literature, the main cause of ulcers in diabetic hand infections was indicated as cutting/penetrating

injuries and minor traumas. However, papers from subtropical African countries reveal the common cause of ulcers as insect bites, bee stings, and human bites (38,41). In our study the two most common causes were injury during saw and hammer use in 5 patients (29.4%) and injury due to inappropriate nail cutting in 3 patients (17.6%).

The high presence of diabetic foot (23.52%) among our cases may be owing to the fact that the two centers included in our study were well-known as diabetic foot centers. Causative agents were detected in the tissue culture of only two patients (14.29%). The patients may have used antibiotics before presenting to centers for treatment. Invasive fungal agents are rarely seen in diabetic foot infections just as in diabetic hand infections. In this case, attention should be paid in terms of progression to amputation. Fungal etiology was observed in one patient (5.88%) among our cases. This may have been due to the lack of a swab culture specimen in our clinics because of its low specificity and sensitivity. In the pool analysis of the literature, this rate was 7.83%, similar to our findings. It is known that fungal etiology is associated with the risk of amputation, especially in diabetic foot

cases (43). Progression to amputation in one patient with fungal infection suggests that fungal etiology may also be associated with poor outcome of treatment in diabetic hand infections. Additionally, none of our patients died. This may have been due to a more specific approach to the illness.

In conclusion, it should be remembered that diabetic hand injuries often occur when using hand tools such as hammers, saws, and knives, and when cutting nails. These patients should be treated carefully and should be warned about using hand tools and safety gloves. If possible, nail care should be performed by a relative who has no neuropathy or visual problems. Since hands are an important part of life, it is necessary to apply conservative treatment rather than amputation. Our patients did not undergo any major amputations. Accompanying diseases are very common in patients with diabetic hand infection. Patients should consult experienced health care professionals and consider a quick treatment.

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