The Journal of Foot & Ankle Surgery ■■ (2017) ■■–■■

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Original Research

Risk Factors and Frequency of Ingrown Nails in Adult Diabetic Patients

Secil Vural, MD [1], Seher Bostanci, MD [2], Pelin Koçyigit, MD [2], Deniz Çaliskan, MD [3], Nilgun Baskal, MD [4], Nursel Aydin, MD [5]

[1]*Medical Doctor, Department of Dermatology and Venereology, Faculty of Medicine, Ankara University, Ankara, Turkey*
[2]*Professor, Department of Dermatology and Venereology, Faculty of Medicine, Ankara University, Ankara, Turkey*
[3]*Professor, Department of Public Health, Faculty of Medicine, Ankara University, Ankara, Turkey*
[4]*Professor, Department of Endocrinology and Metabolism, Faculty of Medicine, Ankara University, Ankara, Turkey*
[5]*Professor, Department of Neurology, Faculty of Medicine, Ankara University, Ankara, Turkey*

ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
diabetes mellitus
ingrown nails
monofilament
neuropathy
onychocryptosis
onychogryphosis
onychomycosis
vasculopathy

ABSTRACT

The present study evaluated the properties of nails, frequency of ingrown nails in patients with type 2 diabetes mellitus (DM), risk factors for developing ingrown nails, and effect of diabetic polyneuropathy and vasculopathy on the development and outcome of ingrown nails. Our 6-month epidemiologic prospective study included 300 patients with type 2 DM attending a DM outpatient clinic for routine examinations. The general characteristics and foot changes of the study population were investigated. Diabetic polyneuropathy and vasculopathy were evaluated using a biothesiometer, monofilament tests, and arterial Doppler ultrasonography. The frequency of ingrown nails was 13.6%. Multivariate analysis with logistic regression showed that body mass index (odds ratio [OR] 1.077, 95% confidence interval [CI] 1.007 to 1.15; $p = .03$), previous trauma (OR 2.828, 95% CI 1.017 to 7,867, $p = .042$), a weak dorsalis pedis pulse (OR 2.72, 95% CI 1.17 to 6.30, $p = .02$), trimming type (OR 2.3, 95 CI 1.06 to 4.98), $p = .35$), onychogryphosis (OR 9.036, 95% CI 2.34 to 34.87, $p = .001$), and subungual hyperkeratosis (OR 4.3, 95% CI 1.99 to 9.3, $p = .001$) were predictive variables for ingrown nails in our population. The incidence of onychomycosis was significantly greater in patients with ingrown nails ($p = .032$) than in patients without ingrown nails. The nail curvature ratio was greater in the patients with ingrown nails than in the group with normal nails. Arterial Doppler ultrasound examinations showed peripheral arterial disease in 19 patients (46.9%) with ingrown nails. The prevalence of ingrown nails was greater in the patients with DM than in the healthy population. Our results indicate that nail type, nail morphology, and diabetic vasculopathy affect the formation and evolution of ingrown nails.

Ingrown nails, a painful condition that can cause the loss of labor and productivity, are seen frequently in dermatology clinics. Their recurrent nature makes ingrown nails an important cause of morbidity. Studies have reported an increased prevalence of ingrown nails among patients with diabetes mellitus (DM); however, they have not explored the variety of risk factors that contribute to onychogryphosis in DM populations (1–3). Controversial results have been reported regarding the effect of metabolic parameters such as abnormal levels of glycohemoglobin, low-density lipoprotein, and fasting glucose (1,2). In 1 study, poor hygiene and a decreased frequency of nail clipping was associated with an increased frequency of onychocryptosis (2).

It has been accepted that diabetic sensorimotor polyneuropathy and peripheral vascular disease contribute to the development of foot ulcers. In the general DM population, 68% of DM patients will have foot pathology, including calluses, sensory neuropathy, hammer toes, and autonomic neuropathy (4). The loss of protective sensation could lead to late recognition of ingrown nails in patients with DM. Furthermore, patients with DM are prone to bacterial and fungal infections of the feet, which enhance the progression of ingrown nails. Peripheral vascular disease in these patients has also been shown to increase nail thickness and disrupt the nail structure. An inconspicuous ingrown nail in a diabetic individual can lead to increased morbidity and even amputations, which, in return, results in increased treatment costs.

In the present study, we evaluated the frequency, clinical features, and relationship with possible risk factors for the development of ingrown nails in a population with DM. We evaluated peripheral neuropathy and vasculopathy to obtain information on their roles in the development of ingrown nails.

Funding: None reported.
Conflict of Interest: None reported.
Address correspondence to: Secil Vural, MD, LMU Dermatologie and Allergologie, Frauenlobstrasse, Munich 9-11 80337, Germany.
E-mail address: secilsaral@gmail.com, Secil.Vural@med.uni-muenchen.de (S. Vural).

1067-2516/$ - see front matter © 2017 by the American College of Foot and Ankle Surgeons. All rights reserved.
https://doi.org/10.1053/j.jfas.2017.10.006

Patients and Methods

The present prospective study included adult patients with type 2 DM who had presented to the Ankara University Medical Faculty's endocrinology and metabolism outpatient clinic for routine examination. The Ankara University ethics committee approved the present study, and all included patients provided written informed consent. Consecutive patients aged 18 to 65 years with a diagnosis of type 2 DM who gave informed consent were included in the present study. The study design was conceptualized by 3 of us (S.B., D.Ç., N.B.). Using the Clopper-Pearson formula, a minimum sample size of 215 patients was needed to produce 2-sided 95% confidence intervals (CIs) with a width equal to 0.100 for the given frequency of ingrown nails (15%) in the diabetic population (1,2,5). For the present study, 300 type 2 DM patients were evaluated during a 6-month period.

A dermatologic examination of the feet was performed for each patient, and changes in the nail units and foot were noted (S.V., S.B., P.K.). In patients with suspected tinea pedis, the dermatophyte infection of the nail was evaluated under a microscope with a native preparation containing potassium hydroxide. The potassium hydroxide solutions were prepared and evaluated by a single, highly experienced technician (Metin Alisinanoglu), who was unaware of the study details.

The studied population was divided into 2 groups, patients with and without ingrown nails. The patients with ingrown nails were compared with the patients without ingrown nails with respect to age, gender, weight, body mass index (BMI), occupation, inappropriate shoe use, disease duration, treatment, onychomycosis, and other nail abnormalities. Hyperhidrosis was evaluated using the patients' history and clinical examination (P.K., S.V.).

The neurologic examination was performed by 2 of us (S.V., N.A.). Diabetic peripheral neuropathy was evaluated using monofilament and vibration perception threshold testing. Monofilament testing was performed using a Semmes-Weinstein 5.07/10-g monofilament at 8 points in each foot, including the plantar aspect of the first, third, and fifth digits; the plantar aspect of the medial, central, and lateral aspect of the midfoot; the posterior of the plantar foot; and the point between the first and second toes on the dorsal surface of the foot (Fig. 1).

The test results were considered weak if the patients could not describe the localization although they could feel the monofilament. The test result was considered negative if the patient could not feel the monofilament at any 1 point. The vibration perception threshold was measured using a biothesiometer with a voltage value of 0 to 50 V for each patient. The patients were blindfolded during the measurements. The patient's peripheral pulse was evaluated with manual palpation by 2 of us (S.V., N.A.). All the patients with ingrown nails underwent an arterial Doppler ultrasound examination by an independent radiologist. Loss of triphasic waveform, increased peak systolic velocity, and spectral broadening and visualization of stenosis were the parameters used in the diagnosis of peripheral arterial disease. The patients with ingrown nails were also evaluated for the type, grade, and localization of the ingrown nails, medial or lateral rotation of the great toe, previous treatments, and symptoms. Onychocryptosis was classified as stage I when only slight erythema and edema on adjacent tissue was present, with pain experienced with pressure. Onychocryptosis was considered stage II when the patient had pain with prominent edema and purulent discharge. Onychocryptosis was classified as stage III in the case of chronic inflammation, granulation tissue, and hypertrophy of the adjacent tissue. A type I ingrown nail is caused by incorrect trimming and other precipitating factors but the nail plate is normal. This type is also known as a subcutaneous ingrown nail. Type II is seen in individuals with hypertrophy of the tissue surrounding the nail plate. Type III is considered present for ingrown nails caused by overcurvature of the nail plate, such as pincer nails or onychogryphosis. The ingrown nail stages and types are shown in Figs. 2 and 3, respectively.

For all patients, the nail thickness was measured in millimeters using a Vernier caliper. The nail curvature ratio and medial and lateral angles were evaluated using anterior photographs of the toe and toenails (Fig. 4). This method was used previously by Pearson et al (6) to investigate the effect of the nail structure on the formation of ingrown nails. The data were recorded by 2 of us (S.V., N.B.). The statistical data were evaluated by an experienced statistician (Zeynep Biyikli) independently of the study. These data were evaluated statistically using the Mann-Whitney *U*, Kruskal-Wallis, and χ^2 tests and multivariate analysis with logistic regression. The odds ratios (ORs) and 95% CIs were evaluated if applicable; p Values < .05 were interpreted as statistically significant.

Results

Ingrown nails were observed in 41 of the 300 patients (13.6%). The median age was 57 (range 23 to 65) years for the DM patients with ingrown nails. Ingrown nails were more frequent in the females (28 versus 13) than in the males. The general characteristics of the diabetic patients included in the study are summarized in Table 1.

Fig. 1. Monofilament testing points for 8-point assessment.