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Abnormal foot angles has an association with ingrown toenail

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Abstract

Background: Onychocryptosis, frequently termed ''ingrown toenail'' is a common foot problem in routine dermatology and orthopaedic clinical practice which leads to pain and disability. Although the aetiology of ingrown toenail is not well understood various associated risk factors have been identified with the pathogenesis.

Material and methods: This study was a retrospective investigation of 170 patients with hallux valgus and lateral border ingrown toenail of all stages. The patients were compared with a control group. The radiologic assessment in both groups included right hallux valgus angle, left hallux valgus angle, right first and second intermetatarsal angle, and left first and second intermetatarsal angle.

Results: There were 121 female and 49 male patients in the case group and 68 female and 32 male in the control group. The mean age of the case group was 41.1 years and 41.1 years in the control group. A statistically significant difference was found between the case and the control groups in terms of the right hallux valgus angle variable.

Conclusion: The abnormal hallux valgus angle and the abnormal intermetatarsal angle plays an important role in ingrown toenail aetiology. The X-rays of the feet should be performed to determine the susceptibility of the patients who are admitted to the hospital for ingrown toenail in order to prevent other toes ingrown toenail and for planning the treatment of the patients with an ingrown toenail.

1 | INTRODUCTION

Onychocryptosis, frequently termed ''ingrown toenail'' is a common foot problem in routine dermatology and orthopaedic clinical practice which leads to pain and disability.[1-3] Although the aetiology of ingrown toenail is not well understood various associated risk factors have been identified with the pathogenesis.[4] It is known that there is an association between hallux valgus angle (HVA) and ingrown toenail, it has been reported that increased HVA in the patients with ingrown toenail.

The objective of this study was to analyse the relationship between the HVA and intermetatarsal angle (IMA) with the ingrown toenail. There were 121 female and 49 male patients in the case group and 68 female and 32 male in the control group. The mean age of the case group was 41.1 years and 41.1 years in control group. A statistically significant difference was found between the case and the control groups in terms of right HVA variable. In this article we found that IMA has an association with ingrown toenail, too. The X-rays of the feet should be performed to determine the susceptibility of the patients who are admitted to the hospital for ingrown toenail in order to prevent other toe ingrown toenail and for planning the treatment of the patients with ingrown toenail.

2 | PATIENTS AND METHOD

The study was a retrospective investigation of 170 patients between January 2016 and January 2020, examined and diagnosed in

the outpatient departments of our hospital. with hallux valgus and lateral border ingrown toenail of all stages (Table 1).[5] The patients were compared with a control group, in the same age range with the patient group, whose foot radiographs were obtained from the patients admitted to our hospital's Orthopaedics and Traumatology department and emergency department with blunt foot trauma and without any fracture in the foot.

The study protocol contained the age, sex, and affected side. Basic demographic and clinical details were obtained from all patients and from the control group. The diagnosis of all the patients in both groups were established by clinical history, physical examination, X-ray findings. All cases in both groups were evaluated according to the inclusion and exclusion criteria (Table 2). All patients were informed about the procedure and objectives of the study, and they have signed a written informed consent form to voluntarily participate in the study. This study was approved by the local ethics committee.

The radiologic assessment in both groups included right hallux valgus angle (RHVA), left hallux valgus angle (LHVA), right first and second intermetatarsal angle (RIMA), and left first and second intermetatarsal angle (LIMA). The HVA is between the axis of the first metatarsal and the axis of the proximal phalanx of the first toe. A normal angle is ≤15°. The IMA is drawn between the first and second metatarsal shaft on axial view of the foot. A normal value is considered to be under 9°. All of the measurements of the foot radiographs were evaluated by one radiologist who was blinded to the clinical information of the patients.

The X-ray evaluation was performed by visualisation of the affected foot and nonaffected foot for comparison. All X-ray examinations and the measurements of the X-ray views of the patients' and the control group were performed by the same radiologist.

2.1 | Statistical analysis

A sample size of 10 patient per group was required to provide 80% power to detect differences at an α level of .05 to indicate significance. The results are presented as the means ± standard deviation (SD), number, and percentage. A normality test was performed before the statistical analysis with t-test. The comparisons were performed using the chi-square test or Fisher's exact test for count data (gender), and the independent-sample t-test for measurement data (age). To compare the two groups, the Levene's test for equality of variances was used. $P < .05$ was considered statistically significant. SPSS 20.0 for Windows (SPSS, Inc Chicago, IL) was used to perform statistical analysis.

3 | RESULTS

None of the patients in both groups was lost to follow-up. A total of 170 patients with ingrown toenail were enrolled in the study. There were 121 female and 49 male patients in the case group and 68 female and 32 male in the control group. The mean age of the case group was 41.1 ± 6.6 (range: 12-82) years and 41.1 ± 7.0 (range: 13-82) years in the control group. Both case group and control group were similar to each other at baseline demographics such as gender, and age. There were no significant differences in patient characteristics among the study groups.

What's known

- Onychocryptosis, frequently termed ''ingrown toenail'' is a common foot problem in routine dermatology and orthopaedic clinical practice which leads to pain and disability. Although the aetiology of an ingrown toenail is not well understood various associated risk factors have been identified with the pathogenesis. It is known that there is an association between hallux valgus angle and ingrown toenail, it has been reported that increased HVA in the patients with an ingrown toenail.

What's new

- There were 121 female and 49 male patients in the case group and 68 female and 32 male in the control group. The mean age of the case group was 41.1 and 41.1 years in the control group. A statistically significant difference was found between the case and the control groups in terms of the right hallux valgus angle variable. In this article, we found that intermetatarsal angles have an association with an ingrown nail too.

A statistically significant difference was found between the case and the control groups in terms of RHVA variable ($P = .018$). It was determined that RHVA of the case group was statistically significantly lower than the control group. In terms of LHVA variable, no statistically significant difference was found between the case and the control groups ($P = 0{,}204$). In terms of RIMA variable, no statistically significant difference was found between the case and the control groups ($P = 0{,}112$). A statistically significant difference was found between the case and the control groups in terms of LIMA variable ($P = .021$). The LIMA of 59 people in the case group was defective and 74 people in the control group had normal LIMA. It was determined that the LIMA of the case group was statistically significantly higher than the control group. It was observed that 170 individuals in the case group had 40 right, 28 left, and 102 multiple ingrown toenails. In terms of ingrown nail type, 48 of the patients were traumatic, 58 were juvenile, and 64 were late onset—dystrophic. There was no statistically significant relationship between ingrown toenail and RIMA and LIMA.

4 | DISCUSSION

An ingrown toenail is a common problem that can cause pain, discomfort and even sepsis.[6] The anatomical characteristics of nail structure have been described as potential risk factors for an ingrown toenail.[7] The increase in nail fold width, decreased nail

thickness, and medial rotation of the toe is reported as 3 critical anatomical predispositions by Langford et al[8] An upturned pulp deformity, nail fold hypertrophy together with a deeper nail groove, incurvatum of the nail plate, and upturned abnormality of the distal part of the distal phalanx are the other anatomical abnormalities that are described in patients with an ingrown toenail.[9] Parrinello et al reported a significant and high correlation between the shape of the proximal aspect of the nail plate and the phalangeal base.[10] Pearson et al found no difference in curvature or axis between the patients with or without an ingrown toenail.[11] Improperly trimmed nails, tight or poorly shaped shoes, abnormal nail shape and hyperhidrosis have been described as extrinsic risk factors,[3,10,12] and congenital and heredity pathologies have been described as intrinsic risk factors.[1] The internal pressure role that the distal phalanx on the lateral edge of the nail could play role in developing an ingrown toenail.[1] Foot wear that places a lot of pressure on the big toes, such as socks and stockings that are too tight or shoes that are too tight, narrow or flat for the feet and toenail injury, including stubbing the toe, dropping something heavy on the foot or using the feet during athletic activities can make the patients especially prone to getting ingrown toenails. Activities in which the patients repeatedly kick an object or put pressure on their feet for long periods of time, such as jogging, ballet, football, soccer and kickboxing, can cause toenail damage and increase the risk of ingrown toenails. However, the most common cause is tight shoe wear or improper grooming and trimming of the nail. Biomechanical imbalance between the great toe and second toe in an ill-fitting shoe is another theory in aetiology.[1] Although some authors have reported higher prevalence in patients with Greek feet types which the great toe is shorter than the second toe,[8,13] other authors have found higher prevalence with Egyptian feet types in which the great toe is longer than the second toe.[14]

There are some variables such as abnormal interphalangeal angle (IPA), HVA and articular set angle of the distal phalanx that may represent possible risk factors in the pathogenesis of ingrown toenail.[6]

There are studies that reported no association between the phalangeal and forefoot alignment, and ingrown toenail. Darwish et al reported that the abnormal HVA in the toes with ingrown toenail was 60% which was significantly higher than in contralateral toes (30%) and in normal toes of the control group (12%). The abnormal IPA in the toes with ingrown toenail was 85%, and this percentage was significantly higher than in contralateral toes (50%) and in normal toes of the control group (20%). They reported that increased HVA and IPA was associated with ingrown toenail. However, they found no significant difference in angles representing the forefoot alignment in patients with or without ingrown toenail.[6] Kose et al retrospectively reviewed X-rays of 81 patients with lateral border ingrown toenail. They measured the

TABLE 1 The stages of ingrown toenail

Stage 1	**Erythema, trace oedema and pain at the lateral nail fold**
Stage 2	Increased pain discharge from the edge of the nail, and signs of bacterial paronychia
Stage 3	Hypertrophic granulation tissue forms on the lateral wall

TABLE 2 Major inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
1. Symptomatic ingrown toenail	1. Medial or bilateral ingrowing nail edge 2. Subungual exositosis 3. Lacking foot radiographs 4. Patients with foot fractures 5. Patients with previous foot fractures 6. Congenital foot deformity or congenital foot malformation 7. Pregnancy or lactation 8. Previous surgery for hallux valgus 9. Previous surgery for ingrown toenail 10. Arthritis of the foot 11. History of gout arthritis 12. History of diabetes mellitus or incipitus 13. History of haematological diseases 14. History of systemic inflammatory, autoimmune, or peripheral vascular disease, such as deep venous thrombosis or bleeding disorders 15. Metatarsal bone tumour or cyst 16. Radiculopathy or peripheral neuropathy around the foot such as nerve entrapment or tarsal tunnel syndrome 17. Osteomyelitis of the affected foot 18. Complex regional pain syndrome 19. Clubfoot, pes cavus, or pes calcaneovalgus 20. Radiological deformity of the hindfoot or midfoot 21. Malignant disease 22. Psychiatric patients

HVA, IMA and hallux IPA and they found no association between forefoot alignment and ingrown toenail.[7] In our study, we did not measure the IPA and this is one of the limitations of our study. However, unlike Kose et al we found that the abnormal HVA and the abnormal IMA plays an important role in ingrown toenail aetiology. To our opinion, this issue is the novelty of this study contributing to the literature.

There are some studies reported that bone-related comorbidities including phalangeal alignment and forefoot alignment are associated with an ingrown toenail.[1,6] In a case–control study, Cordoba-Fernandez et al, found an association between the ingrown toenail and hallux IPA.[1] Cho et al reported that longitudinal malalignments of the bones, such as varus or valgus deformities of ankle, foot and toe, increased the risk of ingrown toenail rather than axial malalignments, such as hammer toe, high-arched foot or flexion deformities.[2] The varus or valgus deformities of ankle, foot and toe increased the risk of ingrown toenail more than 1.5 times over that in the control group.[2]

The main aim of this study was to determine whether there is an association between the ingrown toenail and with the pathological HVA and IMA. In our study, we found that RHVA of the case group was statistically significantly lower than the control group. Additionally, the LIMA of the case group was statistically significantly higher than the control group.

There are some limitations to our study. First, we were unable to control the types of shoes that the patients wore. Second, we did not classify the feet of our patients and the control group according to foot types, such as Egyptian foot, square foot or Greek foot.[14] Although there are few studies reported the association between abnormal hallux IPA and ingrown toenail and these studies have controversial results,[1,6,7] we did not measure the IPA. Additionally, the patient numbers and subject numbers in the control group should be increased.

In conclusion, the abnormal HVA and the abnormal IMA plays an important role in ingrown toenail aetiology. The X-rays of the feet should be performed to determine the susceptibility of the patients who are admitted to the hospital for ingrown toenail in order to prevent other toes ingrown toenail and for planning the treatment of the patients with an ingrown toenail.

DISCLOSURES

No conflict of interest.

ETHICAL APPROVAL

The study was approved by the Ufuk University Faculty of Medicine non-interventional clinical trials ethics committee (Approval no: 2021_03_01)

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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