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Evaluation of The Relationship Between Ingrown Toenail and Hallux Interphalangeal Angle

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ABSTRACT

Commonly encountered ingrown toenail has been associated especially with shoe properties and nail care. The objective of this study was to investigate the relationship between hallux interphalangeal angle (HIA) and ingrown toenail.

A total of 28 patients diagnosed with ingrown toenail without foot deformity except hallux interphalangeal angle were included in the study. Twenty-eight persons without any complaint of ingrown toenail or any foot deformity, and who presented due to any complaint other than lower extremity were enrolled as the control group. Hallux interphalangeal angle was calculated both in patients and control subjects with dorsoplantar projection of the foot, and compared between the groups.

The groups were similar in age and gender, but showed differences in terms of HIA. The mean HIA value was significantly higher in the patient group compared to the control group. HIA was higher in male patients with ingrown toenail, while this correlation could not be shown in female patients.

Increased HIA may be among the risk factors for ingrown toenail. Deformities of the forefoot should be evaluated in patients with ingrown toenail.

Key Words: Ingrown toenail, hallux interphalangeal angle, related factors

Introduction

Also known as unguis incarnatus or onychocryptosis, ingrown toenail is a common problem in clinical practice, and a painful disease of toenails. It affects daily activities, and quality of life, causing discomfort. Ingrown toenail which is characterized by the growth of toenail toward the skin can occur in any toe, although it mainly affects the hallux (1). Ingrown toenail is a common cause of toe pain, toenail edges push the surrounding skin, leading to pain, inflammation, and sometimes bleeding. Ingrown toenail is resulted from the conflict between the nail plate and soft tissue. Ingrown toenail occurs when the nail plate grows towards the adjacent periungual skin, and acts as a foreign body, causing inflammation and infection. Although the main symptom is pain, ingrown toenail leads to difficulty in walking, infection, and decreased quality of life, if left untreated. Ingrown toenail can be easily diagnosed, and there are numerous treatment approaches (2).

Ingrown toenail more commonly affects young adults in the second and third decades of life. Although it is commonly encountered, only little data exist about the prevalence and incidence of ingrown toenail. The prevalence of ingrown toenail has been reported between 2.5% and 5% (3). The highest incidence is seen in persons aged between 11 and 30 years (4). Although some underlying factors have been described, the etiology has not been fully understood. Many factors have been suggested to affect ingrown toenail. Among these factors, shoes and related properties have been reported as the most effective causes. These properties include improper nail trimming, fitting-shoes, hyperhidrosis, poor foot hygiene, abnormal nail shapes, trauma, anatomical anomalies, and the use of epidermal growth factor (5, 6). In addition, congenital and hereditary risk factors have also been associated with ingrown toenail. Some studies have proposed anatomical anomalies and certain forefoot shape as possible risk factors in the development of ingrown toenail (7).

In addition to the described risk factors, it has been suggested that hallux interphalangeal angle is increased and hallux valgus deformity is more frequently observed in cases of ingrown toenail (1, 7). In this study, we aimed to investigate the

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Fig. 1. Obliquity angle: A tangent was drawn to the articular surface of the proximal phalangeal head (a, b). A perpendicular line (c, d) was then extended from the longitudinal bisection of the proximal phalanx. Obliquity is the angular relationship between this perpendicular line and the mentionated tangent

Fig. 2. Joint deviation angle: Tangents were drawn to articular surfaces of the distal phalangeal base (a, b) and the proximal phalangeal head (c, b). Joint deviation is the angular relationship between these two tangents (ABC)

relationship between ingrown toenail and hallux interphalangeal angle in Turkish population.

Material and Methods

A total of 28 patients diagnosed with ingrown toenail without foot deformity except hallux interphalangeal angle deformities were included in the study. Twenty-eight persons without any complaint of ingrown toenail or any foot deformity, and who presented due to any complaint other than lower extremity were included as the control group. Power of the study was calculated as 86% with two-way post-hoc power analysis using G*power 3.1.9.2. software considering α as 0.05, and effect wide as 0.8 for "difference between the means of two groups".

Persons who previously underwent surgery due to rearfoot and forefoot osteoarthritis or deformities, those with a previous diagnosis of ingrown toe, major foot trauma and persons with any foot deformity were excluded from the study.

All patients and control group underwent foot dorsoplantar radiograph. The method recommended by Sorto et al. was preferred for the measurement of hallux interphalangeal angle (8). First angel was measured between proximal phalanx articular surface of the big toe and longitudinal axis (Figure 1), second angle between distal phalanx articular surface and longitudinal axis (Figure 2) and third angle between proximal phalanx articular surface and distal phalanx articular surface (Figure 3). Sum of the three angles was calculated as the hallux interphalangeal angle (HIA).

The study was approved by the local ethics committee of our hospital (Date: 13/03/2019, No: 2017-KAEK-189-2019.03.13.10), and was conducted in accordance with the principles of the Declaration of Helsinki.

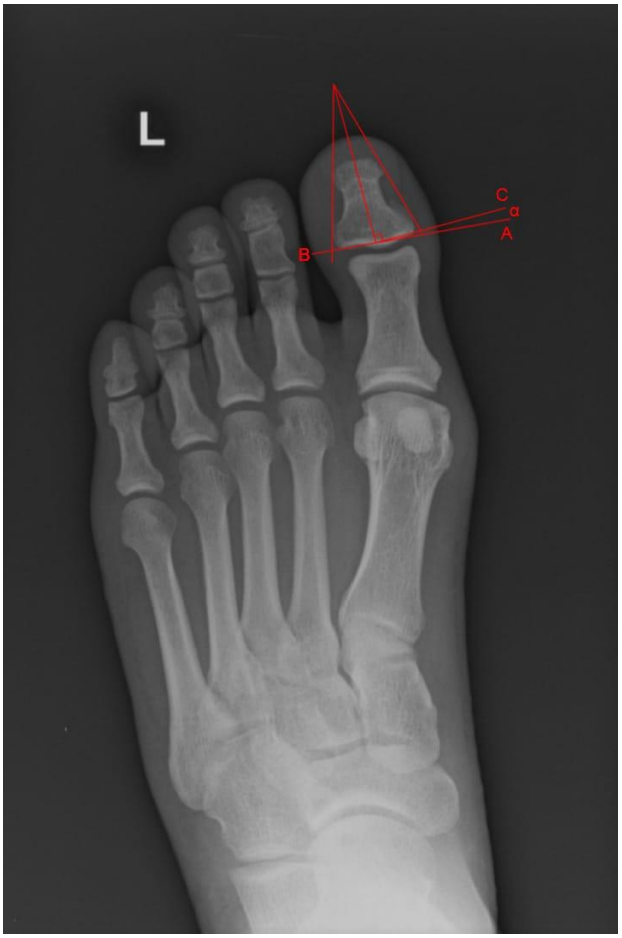

Fig. 3. Asymmetry angle: A tangent was drawn to the articular surface of the distal phalangeal base (a, b). A perpendicular line (c, d) was then extended from the longitudinal bisection of the distal phalanx. Asymmetry is the angular relationship between this perpendicular line and the above mentioned tangent (ABC)

Statistical Analysis: SPSS 20.0 package program was used in statistical analysis. Distribution of data was examined with histograms and Kolmogorov-Smirnov test. HIA was normally distributed, while age was non-normally distributed. HIA results were expressed as mean and standard deviation, and compared between the groups with student *t* test. Age was expressed as median and interquartile range (IQR) and analyzed between the groups with the "Mann-Whitney U" test. Categorical variables were analyzed with Chi-square test and expressed as frequency (n) and percentage (%). $p<0.05$ values were considered statistically significant.

Results

The median age was 22 years (range: 8-73) in the patient and 22.5 years (range: 7-68) in the control group. Of all patients, 60% were male and 40% were female. Patient and control groups were similar in age (p=0,912) and gender (p=0,301). HIA was found as 15.3 ± 4.2 degrees in the patient (8.1-25.1 degrees), and 10.6 ± 2.8 (range: 5.2-15.5 degrees) in the control group. HIA value was significantly higher in the patient group compared to the control group (p<0.001) (Table 1) (Chart 1).

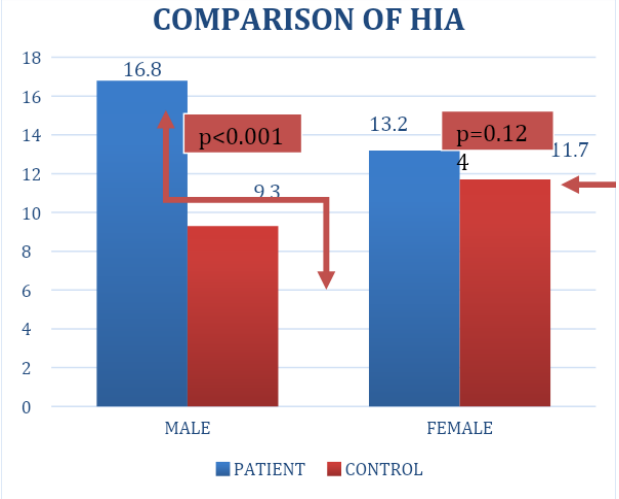

Chart 1. Comparison of HIA according to gender

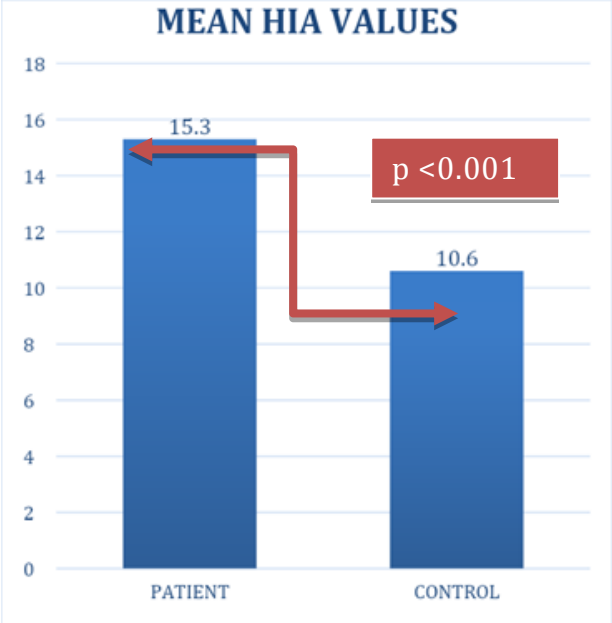

Chart 2. Mean HIA values in patients and control groups

The mean HIA value was found as 16.8±4.7 degrees in male patients with ingrown toenail (range: 8.1-25.1), and 9.3±2.7 degrees (range: 5.2-12.8) in female patients. HIA angle was higher in male patients with ingrown toenail compared to the male control subjects (p<0,001). The mean HIA value was 13.2±2.3 degrees in female patients with ingrown toenail (range: 9.5-18.5), and 11.7 ± 2.4 degrees in the female control subjects (range:

Table 1. Comparison of patient and control groups

	Patients (n=30)	Control (n=30)	Test	p
Age, median (IQR)	22 (24)	22.5 (22)	U=442.5	0.912
Gender, n (%)			X2=1.071	0.301
Male	18 (60)	14 (46.7)		
Female	12 (40)	16 (53.3)		
HIA, mean ± SD	15.3 ± 4.2	10.6 ± 2.8	t=5.085	<0.001

IQR: Interquartile Range, SD: Standard Deviation

Table 2. Comparison of HIA values in patient and control groups according to gender

		Patient (n=30)	Control (n=30)	Test	p
Male, mean ± SD					
	HIA	16.8 ± 4.7	9.3 ± 2.7	*t=5.3*	*<0.001*
Female, mean ± SD					
	HIA	13.2 ± 2.3	11.7 ± 2.4	*t=1.59*	0.124

6.4-15.5 degrees). No significant difference was found between female participants with and without ingrown toenail in terms of HIA (p=0.164) (Table 2) (Chart 2).

Discussion

Ingrown toenail is among the commonly encountered conditions by orthopedists. Pain caused by the disease may lead to a significant decrease in quality of life. In addition to pain, ingrown toenail has been reported to cause decrease in lower extremity functions and fallings (9). Ingrown toenail may become a painful condition requiring surgical treatment. Widely accepted theory in pathogenesis is development of pain, sepsis, and formation of granulation tissue by penetration of lateral nail fold by the edge of the nail plate (10). Slightly high male-to-female ratio has been reported for ingrown toenail (11). Similarly, in our study the rate of male patients with ingrown toenail was higher. Predisposing factors of ingrown toenail are most commonly seen in young people. Perspiration is increased in this period and nail folds become soft. In addition, participation in sport activities lead to formation of nail spicules that may penetrate the lateral skin fold of the nail apparatus. In our study, the mean age of the patients with ingrown toenail was found as 22 years. Especially shoes and improper nail trimming are accused of ingrown toenail. However, in the present study we demonstrated that increased first interphalangeal angle was associated with ingrown toenail. Most of the studies on ingrown toenail has focused on treatment methods. Because generally ingrown nails are accepted as a minor health problem, it has somewhat been neglected in the literature. Few studies have investigated the etiology of ingrown toenail and predisposing factors. These factors include anatomical features such as wide a nail fold, low nail thickness, and increased medial rotation of the big toe (11), using improper shoes (12), improper nail trimming technique (13), diabetes (14), and medications such as indinavir (15), retinoids (16), and cyclosporine (17).

In a case report by Venkatachalam (18), a recurrent ingrown toenail case has been reported following first metatarsophalangeal articular fusion. It was thought in this case report that biomechanical imbalances related to the first toe may be associated with ingrown toenail. Therefore, in our study we aimed to demonstrate that increased HIA, which affects the alignment of the forefoot, may be associated with ingrown toenail. There were studies in the literature supporting our results (1, 7, 19).

In a study by Cordoba and Fernandez (7), significantly higher HIA angles were reported in patients with ingrown toenail compared to the controls. Similarly, Darwish et al. reported that the incidence of abnormal HIA was higher in patients with ingrown toenail compared to the controls. Recently, in a large study, Cho et al. demonstrated that hallux valgus, varus and pes planus among foot deformities were associated with ingrown

toenail (1). In our study, we showed that the relationship between HIA angle and ingrown toenail applies to the Turkish population. However, there is a few data reporting no correlation between HIA and ingrown toenail. In a study by Kose et al. comparing radiographs of patients with ingrown toenail with healthy control subjects, no significant difference was found between the groups in terms of HIA (20). However, the use of manual markers and rulers in measurement of this angle might lead to significant margin of error.

Our results indicated that the relation between HIA and ingrown toenail was more significant among male patients compared to female patients. Ingrown nails especially affect the patients in their first 20 to 30 years of life (2). Hallux valgus deformity which is characterized by increased HIA, is especially common among women. Female to male ratio has been reported as 15:1 for hallux valgus, which is seen in earlier periods in men (21). Ingrown toenail is seen in similar ages, and may explain this difference.

The relationship of ingrown toenail which is commonly encountered by dermatologists with foot deformities indicate that orthopedic approach may be needed, especially in men. Foot deformities left untreated may result in the recurrence of ingrown toenail after the treatment. On the other hand, formation of ingrown toenails can be avoided by preventive or protective interventions in persons without ingrown toenail, but have an increased HIA. However, further studies are needed to support this.

In conclusion, it was found that ingrown toenail was associated with an increased first interphalangeal angle. Screening of forefoot deformities such as hallux valgus, which is characterized by the increased first interphalangeal angle that is defined as a risk factor for ingrown toenail in male patients, earlier treatment and early intervention to the increased first interphalangeal angle may reduce the incidence of ingrown toenail.

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