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ORIGINAL ARTICLE

Association of hypermobility and ingrown nails

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Abstract Ingrown nail (onychocryptosis) is a common condition with severe pain and various associated morbidities. Although some underlying factors are identified, its etiology remains largely unknown. Generalized joint hypermobility (GJH) is a common entity with clinical features that might prone affected individuals to ingrown nails. Herein, we investigated the incidence of GJH in patients with ingrown nails to determine possible association between hypermobility and ingrown nail formation. Patients 16–50 years of age who were undergoing treatment for ingrown nails at the dermatology clinic were consecutively enrolled into the study. Patients with known rheumatic diseases or orthopedic foot disorders were excluded. All patients were in a pain-free period at the time of examination. The control group was comprised of age- and sex-matched healthy subjects without a history of ingrown nail. Assessment of GJH was made according to Beighton criteria. Local hypermobility was evaluated by measurement of range of motion using a goniometer. Thirty-nine patients (male/female, 17/22, mean age 31.9±11.3 years) and 32 healthy subjects (male/female 12/20, mean age 31.7± 10.4 years) were included. Patients with ingrown toe nails were more likely to have GJH compared to healthy subjects (35.9 vs. 9.4 %, $p=0.009$). Toes with ingrown nails had significantly smaller maximum dorsiflexion angles ($p< 0.001$) compared to toes of healthy subjects. Ingrown nail formation may be associated with GJH. However, when examined locally, there is a limited range of motion in the affected toe rather than hypermobility, which could be due to the degenerative process facilitated by the hypermobility.

Keywords Hallux rigidus · Hypermobility · Ingrown nail · Onychocryptosis

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Introduction

Ingrown nail (onychocryptosis) is a common condition with severe pain and various associated morbidities. Well-defined risk factors for this disorder are ill-fitting shoes, faulty nail trimming, hyperhidrosis, poor foot hygiene, and genetic background. Repetitive or inadvertent trauma has also been postulated as a causative factor [1–4]. Therefore, etiology of ingrown nails seems to be multifactorial, and interaction between all listed factors might be possible.

Excessive range of motion or hypermobility of a joint usually gives symptoms as muscle or joint pain. However, joint laxity could also stay unnoticed in many affected individuals or might be associated with various conditions that have not yet been defined [5–7]. Recently, an association between generalized joint laxity and modification of plantar forces has been described in female soccer players aged 11–21 years [8]. Joint hypermobility increases medial midfoot pressure and loading during walk through changing the foot biomechanics and affecting gait [8]. Ingrown nails are mostly detected on the first toes, where first metatarsophalangeal joints bear the highest pressure [1]. Besides, orthopedic foot problems, like pes planus, are common in hypermobility patients [5].

Generalized joint hypermobility (GJH) is a major component of joint hypermobility syndrome (JHS) which have

some extra features that may prone affected individuals to ingrown nail formation, such as fragile and thin skin, autonomic and proprioceptive sensory neuronal dysfunction resulting in hyperhidrosis and vulnerability to recurrent trauma [9].

Beighton criteria has been used for more than 30 years for the assessment of GJH; however, it has been criticized for including only certain joints and lacking of associated symptoms or conditions in scoring. Brighton criteria are recently introduced for the assessment of JHS and include related symptoms and other extra-articular findings of hypermobility with a sensitivity and specificity of 93 % [5, 9, 10].

The aim of this study was to investigate whether joint hypermobility might be associated with ingrown nails, as well as to investigate the hypothesis that local hypermobility as the neutral and maximum passive dorsiflexion toe angles might play a role on the occurrence of this condition.

Materials and methods

Patients 16–50 years of age who were under treatment for ingrown nails at the dermatology clinic were consecutively enrolled into the study. Patients with known rheumatic diseases or orthopedic foot or lower extremity problems were excluded. They were all treated prior to the study and were in a pain-free condition at the time of the examination. The control group was comprised of age- and sex-matched healthy subjects without history of ingrown nails. Assessment of GJH was made according to Beighton criteria [10]. A total Beighton score ≥4 out of 9 was considered as GJH. Local mobility was evaluated by measuring angles of the affected toes using a goniometer, primarily the first metatarsophalangeal joints. Measured angles were neutral angle of the first toe with respect to plantar line and maximal passive dorsiflexion. Angles were measured bilaterally while the patient was lying supine at neutral position.

Assessment of GJH (Beighton items) was performed by two rheumatologists (AT & BG), and all angle measurements were done by a single rheumatologist (AT). Fifteen patients (30 toes) were reevaluated for the inter- and intra-observer agreements for the assessment of Beighton items and intra-observer reliability of toe angle measurements. Local ethics committee approved the study and written informed consent was obtained from all participants and parents of those younger than 18 years of age.

Intra- and inter-observer agreements for the assessment of Beighton items were given as kappa coefficients. Intra-class correlation (ICC) coefficients were calculated for the intra-observer reliability of toe angle measurements. Numerical and categorical variables of groups were compared by the Student's *t* and chi-square tests, respectively. For the comparison of Beighton scores of groups, the Mann–Whitney *U* test was used. A p value of ≤0.05 was considered significant in all analyzes.

Results

The study group was comprised of 39 patients (male/female, 17/22, mean age 31.9±11.3 years) and 32 healthy subjects (male/female 12/20, mean age 31.7±10.4 years). Ingrown nail was bilateral in 20, unilateral in 19 patients. There was no difference between patient and control groups for their forefoot shape (Greek, Egyptian, or square types) preferred shoe style, foot hygiene, nail trimming frequency, and pattern. Grade of ingrown nails was similar among the patients with or without GJH.

Intra- and inter-observer reliability was evaluated for each Beighton item and the lowest Kappa value was 0.71 ($p<0.001$) for any item (Table 1). The intra-observer agreement for angle measurements was excellent (ICC 0.98, 95 % Confidence interval 0.95–0.99).

Patients with ingrown toe nails had a significantly higher median Beighton score compared to healthy subjects (2 vs 0, $p=0.018$); they were also more likely to have a GJH (35.9 vs 9.4 %, $p=0.009$; Table 2). Interestingly, the only case who had five toes affected had severe GJH with a Beighton score of nine points.

Patients with ingrown nails had significantly smaller neutral, as well as maximum toe dorsiflexion angles compared to healthy subjects (24.7±13.2 vs 33.0±9.9 °, $p<0.001$ and 63.1 ±19.5 vs 79.6±12.8 °, $p<0.001$, respectively). However, affected and unaffected toes of the patients with ingrown toe nails had similar angles (Table 3).

Discussion

Ingrown nail is a common condition with two peak ages (namely, in adolescents and in middle aged to elderly), suggesting different underlying etiological factors [2, 3]. Although several factors have been identified as predisposing

Table 1 Intra- and inter-observer agreement for Beighton items

	Intra-observer		Inter-observer	
	κ	p	κ	p
Touching the floor with palms	1.0	0.005	1.0	<0.001
Knee bending	1.0	<0.001	1.0	<0.001
Elbow bending	0.81	0.001	0.92	<0.001
Thumb touching the forearm	1.0	<0.001	1.0	<0.001
Fifth finger dorsiflexion >90 °	1.0	<0.001	0.71	<0.001

Table 2 Localized and generalized joint hypermobility among patients and healthy subjects

	Patients n=39 (78 toes)	Healthy controls n=32 (64 toes)	p
Age, years	31.9±11.3	31.7±10.4	ns
Sex, female/male, n	22/17	20/12	ns
Toe neutral angle, degrees	24.7±13.2	33.0±9.9	<0.001
Toe maximal dorsiflexion angle, degrees	63.1±19.5	79.6±12.8	<0.001
Beighton total score, median (IQR)	2 (5)	0 (6)	0.018
Generalized joint hypermobility, n (%)	14 (35.9)	3 (9.4)	0.009

All data are expressed as mean±standard deviation (SD) unless indicated

ns nonsignificant, *IQR* interquartile range

individuals to ingrown nails (such as foot anatomy and nail structure), there is also a personal tendency [2, 11, 12]. Patients with ingrown nails often have a positive family history [2]. Similarly, joint hypermobility has also been shown to be familial and displays newly defined associations with many other conditions, such as uterine and rectal prolapse [5].

The results of the study suggest that ingrown toe nails are more common in patients with GJH and are associated with more limited dorsiflexion angle of the great toe. This might appear to be conflicting. However, many studies in the literature reported a limited range of motion in patients with a past history of joint hypermobility [13]. GJH predisposes joints to repetitive trauma and may lead to early degenerative changes and premature osteoarthritis; therefore, may limit joint mobility and cause rigid state earlier than healthy individuals [9].

Limited dorsiflexion of the first toe is defined as hallux limitus, which in time turns to hallux rigidus. Hallux limitus/rigidus in young patients is reported to be usually due to trauma, either acute or chronic, which may not be radiologically recognized earlier; however, it may result in secondary degenerative changes in time [14]. Moreover, change in the first metatarsophalangeal joint flexibility is associated with a variance in hallucal peak pressure and loading and therefore might also predispose an individual to ingrown nail formation [15–17]. Supporting this association, hallux limitus/rigidus has previously been shown to be associated with first toe hypermobility and an increased peak plantar pressure under the hallux which should rather be located under the first metatarsal head [16]. Besides, weakening of the muscles in and around the foot usually results in overpronation. Pregnancy and obesity, two other risk factors for ingrown nails, are also risk factors for hallux limitus/rigidus formation, as they lead to increased pronation [3, 18]. Other groups who are subject to extreme pronation are dancers and sports people in whom ingrown nail formation is also common.

GJH is the fundamental part of JHS. However, JHS have other clinical characteristics in which various organs like skin, nerves, and vessels are involved [5]. Fragility and thinning of the skin, autonomic nervous system dysfunction leading to hyperhidrosis and impaired proprioception may all contribute to the development of ingrown nail formation in JHS [3, 5]. One of the limitations of our study is that we were not able to evaluate skin and nerve functions in our patients.

Joint hypermobility is shown to be more common in children and less common in the elderly; therefore, patients with GJH may have joint laxity at a younger age and may present with complications related to it, such as degenerative changes and hallux rigidus formation, later in the life [9]. Various degenerative arthritic conditions occur after the age of 50 and this might impair accurate assessment of the joint hypermobility. Therefore, we did not include the patients over the age of 50 in this study. Inclusion of this particular age group might strengthen the possible association shown in our study. Another weakness of the study is that it is cross-sectional. Although the number of patients was enough to demonstrate the association between ingrown nails and GJH, prospective studies are needed to investigate if hypermobility is also associated with recurrence of ingrown nails.

The results of this study support the hypothesis that ingrown nail formation may be associated with generalized joint

Table 3 Neutral and maximal dorsiflexion angles of affected and unaffected toes of the patients with ingrown toe nails

	Affected toes (n=60)	Unaffected toes (n=18)	p
Ipsilateral neutral angle, degrees	25.5±13.3	22.2±12.8	ns
Ipsilateral dorsiflexion angle, degrees	62.9±19.4	63.5±20.6	ns
Contralateral neutral angle, degrees	23.1±13.7	25.3±13.1	ns
Contralateral maximal dorsiflexion angle, degrees	62.8±17.6	63.9±25.5	ns

All values are expressed as mean ±SD

ns nonsignificant

hypermobility. However, when examined locally, there is a limited range of motion in the effected toe, which could be due to the degenerative process facilitated by the hypermobility.

Disclosures None.

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