

Original Article

Recurrence and risks after partial matrixectomy for ingrown nails

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ABSTRACT

INTRODUCTION. Ingrown nails (onychocryptosis) is a debilitating condition that often recurs after partial matrixectomy. Therefore, this study investigated the incidence of ingrown nails and identified the risk factors associated with recurrence.

METHODS. This retrospective cohort study analysed electronic health records of orthopaedic surgery patients aged 18+ from Bispebjerg and Frederiksberg Hospitals, Denmark (April 2017-November 2020) to assess recurrence and associated risk factors.

RESULTS. The cohort included 53% females (n = 83) and 47% males (n = 75), with 44% (n = 69) aged 18-28 years. Active smokers constituted 73% (n = 115). Common comorbidities were musculoskeletal disorders (32%, n = 51), endocrine (22%, n = 34) and cardiovascular disorders (15%, n = 23). Recurrence occurred in 34% (n = 54, p < 0.05). Middle-aged individuals (29-40 years: 64%; 41-50 years: 60%) showed slightly higher recurrence rates, though this finding was non-significant (p = 0.07). Males (OR = 0.24, 95% CI, p = 0.000) and smokers (OR = 0.34, 95% CI, p = 0.016) had lower recurrence odds. Complications were significantly higher in recurrence cases (OR = 4.35, 95% CI, p < 0.000), with abscess (100%), paronychia (100%) and onychogryphosis (95%) being the most prevalent.

CONCLUSIONS. Recurrence affected one-third of the cohort, with higher rates being observed in younger and middle-aged individuals, whereas males and smokers had lower recurrence rates.

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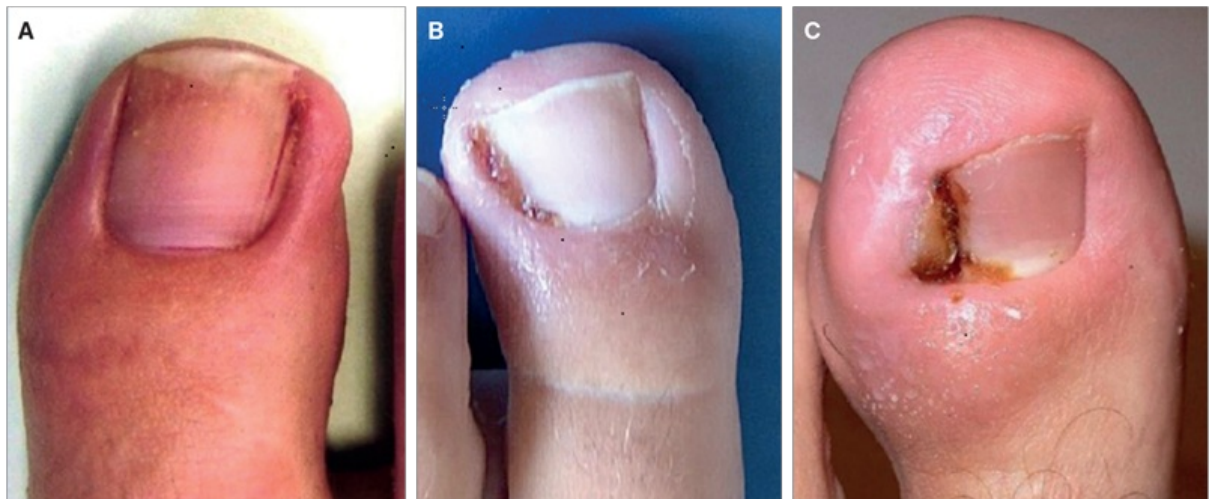
TRIAL REGISTRATION. Not relevant.

Ingrown nails, particularly those affecting the hallux, present a distressing condition characterised by the nail's edge penetrating into the surrounding skin, a condition known as "onychocryptosis". It accounts for about 20% of foot problems in primary care [1].

Ingrown toenails were classified into three stages by Heifetz: Stage I (mild inflammation), Stage II (infection with inflammation) and Stage III (chronic inflammation with granulation and nail fold hypertrophy) (**Figure 1**). Pathogenesis is multifactorial, often triggered by improper nail trimming [2], trauma, tight footwear, age, sex, smoking, obesity, hyperhidrosis, onychomycosis, genetics and anatomical issues. Repetitive trauma and systemic conditions like obesity and diabetes worsen the condition. Management ranges from conservative care (nail hygiene, wide footwear, antibiotics) to surgical options such as nail avulsion, nail bed or fold surgery, and emerging stem cell treatments [3]. Partial matrixectomy is preferred among surgical options owing to its targeted

approach and reduced recurrence rates. It involves selective matrix resection to address the ingrown nail segment and is often combined with procedures like phenol ablation or electrocautery. Phenol ablation uses phenolic acid to chemically destroy nail matrix cells [4]. Electrocautery involves using an electric current to cauterise the affected nail matrix. Recurrence remains a known complication, with reported rates ranging from 2.5% to 5% [5]. Current literature does not conclusively establish risk factors for recurrence, emphasising the need for further research on recurrence and risk reduction. This study aimed to assess the incidence of ingrown nails following partial matrixectomy and identify associated risk factors.

FIGURE 1 Heifetz's classification of onychocryptosis, dividing the condition into three stages: Stage 1 – irritation, redness, swelling and pain of the nail bed (A). Stage 2 – similar symptoms with granulation tissue, seropurulent discharge and ulceration (B). Stage 3 – chronic epithelialised granulation tissue and possible nail-fold hypertrophy (C) [2].



Methods

Study design

This retrospective cohort study analysed outcomes of adult patients (≥ 18 years) who underwent partial matrixectomy for first-toe onychocryptosis at Bispebjerg and Frederiksberg Hospitals, Denmark, between April 2017 and November 2020. Data were extracted from electronic records with approval from the Regional Centre for Data and Research. The study follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. No formal sample size calculation was done due to the retrospective design. Patients with bilateral procedures, prior nail surgeries or incomplete records were excluded. All patients underwent partial matrixectomy using the standardised Winograd or phenolisation method.

Data collection

Data were collected by reviewing the patient files of those who underwent partial matrixectomy, focusing on the following risk factors: age, sex, smoking status and comorbidities, including musculoskeletal, endocrine, cardiovascular, neurological, respiratory, gastrointestinal, genitourinary, ophthalmological, dermatological, otolaryngological and mental health disorders. Recurrence was defined as the return of onychocryptosis symptoms or nail edge regrowth within 12 months, as determined by physician assessment or patient report. Complications were recorded and classified as early (within 30 days) or late (up to 12 months). Two trained

reviewers extracted the data using standardised protocols, with inter-rater reliability being assessed for 10% of cases. Records lacking outcome data were excluded.

Statistics

The data were analysed using IBM SPSS Statistics 19.0. Descriptive statistics, including frequencies and percentages, were computed to summarise the demographic and clinical characteristics of the study population. To assess the association between variables, binary logistic regression was performed, with results expressed as unadjusted ORs along with their corresponding 95% CIs. A two-tailed $p < 0.05$ was set as the threshold for statistical significance.

Ethical considerations

Before data collection, necessary approval (P-2022-439) was obtained from the Regional Centre for Data and Research. Potential study subjects were informed of the research through secure communication channels to maintain security and privacy, and their consent was obtained. Confidentiality was ensured throughout the research.

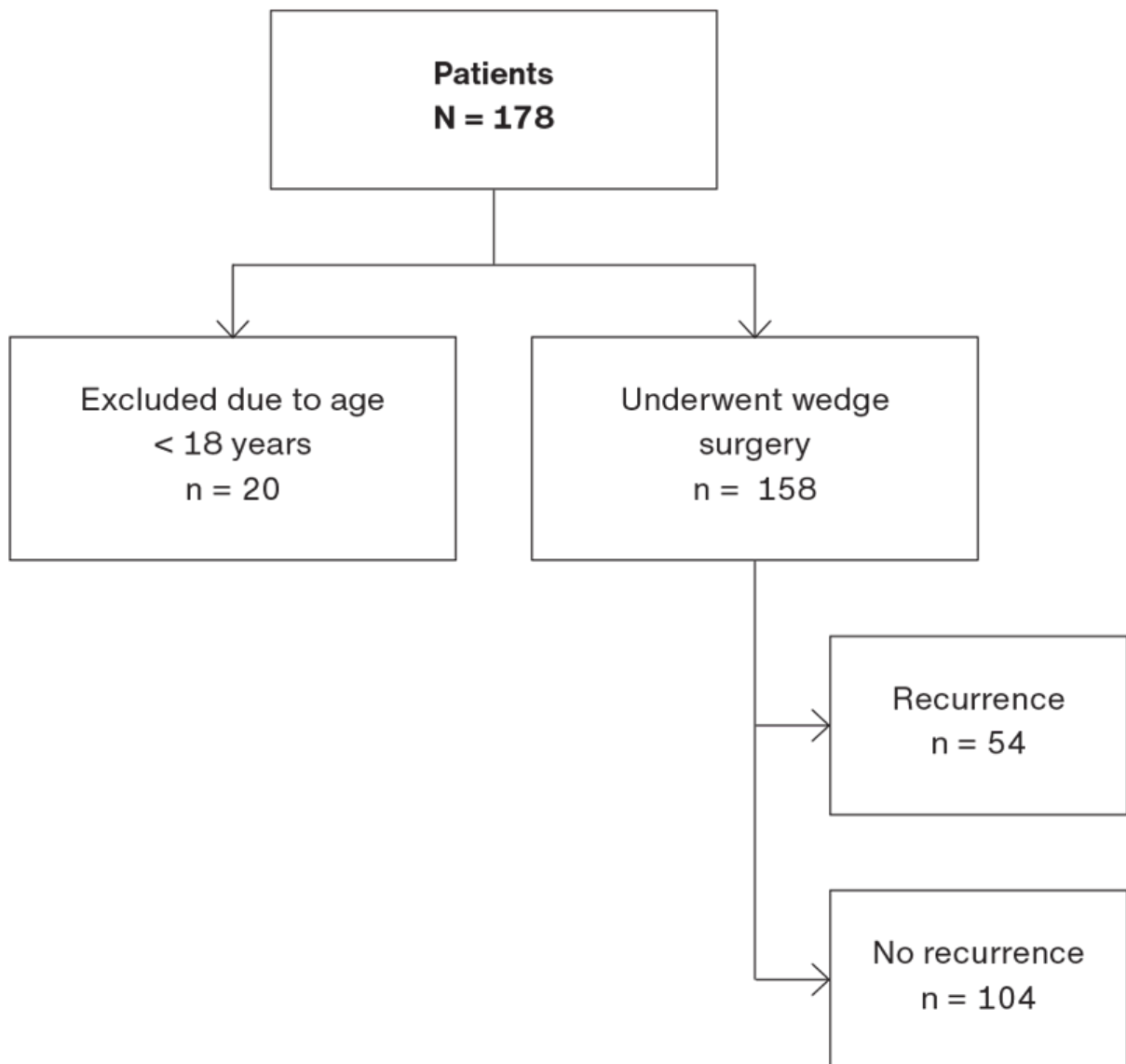
Trial registration: not relevant.

Results

Demographics

Between 2017 and 2022, 178 patients had a matrixectomy performed. Twenty patients were excluded because they were under 18 years of age, leaving 158 patients in the study (**Figure 2**).

FIGURE 2 Flow chart depicting the enrollment process and recurrence rates among study participants.



Among patients, 53% (n = 83) were females and 47% (n = 75) were males. The most prevalent age group was 18-28-year-olds, constituting 44% (n = 69). A total of 73% (n = 115) were active smokers, whereas musculoskeletal disorders (MSD) were the most prevalent comorbidity, affecting 32% (n = 51) of participants, followed by endocrine disorders at 22% (n = 34). Cardiovascular disorders were present in 15% (n = 23) of cases, whereas neurological disorders were reported in 12% (n = 19). Other less prevalent comorbidities included respiratory (8%, n = 13), gastrointestinal (8%, n = 13), genitourinary (8%, n = 12) and otolaryngological disorders (4%, n = 7). Furthermore, dermatological (0.6%, n = 1), ophthalmological (0.6%, n = 1) and mental health disorders (3%, n = 4) were observed (Table 1).

TABLE 1 The socio-demographic distribution and health characteristics among the study participants.

	n (%) ^a
<i>Age</i>	
18-28 yrs	69 (44)
29-40 yrs	35 (23)
41-60 yrs	25 (15)
61-90 yrs	29 (19)
<i>Sex</i>	
Male	75 (47)
Female	83 (53)
<i>Smoking habits</i>	
Active smokers	115 (73)
Non-smokers	18 (16)
Former smokers	25 (11)
<i>Comorbidities</i>	
Musculoskeletal disorders	51 (32)
Endocrine disorders	34 (22)
Cardiovascular disorders	23 (15)
Neurological disorders	19 (12)
Respiratory disorders	13 (8)
Gastrointestinal disorders	13 (8)
Genitourinary disorders	12 (8)
Other	10 (6)
Otolaryngological disorders	7 (4)
Mental health disorders	4 (3)
Ophthalmological disorders	1 (0.6)
Dermatological disorders	1 (0.6)

a) Percentages may not sum to 100 due to rounding.

Primary and secondary outcomes

In this cohort, 54 patients exhibited recurrence, corresponding to an incidence of 34% ($p < 0.05$) (Figure 2). There was a tendency for the age group of 29-50-year-olds ($OR = 1.02$) to have slightly higher recurrence rates, though this association was not statistically significant ($p = 0.07$). A significant association was observed between recurrences and smoking ($OR = 0.34$, $p = 0.016$) and sex ($OR = 0.24$, $p = 0.000$), with lower odds of recurrence in smokers and males (Table 2).

TABLE 2 Association of demographic factors with recurrence rate.

	Patients, n (%)		OR	p value ^a
	recurrence	non-recurrence		
Sex			0.243	0.000
Male	14 (19)	61 (81)		
Female	40 (48)	43 (52)		
Age			1.02	0.07
18-28 yrs	19 (29)	46 (71)		
29-40 yrs	23 (64)	13 (36)		
41-50 yrs	12 (60)	8 (40)		
51-60 yrs	3 (38)	5 (42)		
61-70 yrs	0	13 (100)		
71-90 yrs	0	16 (100)		
Smoking habits			0.34	0.01
Active smoker	38 (33)	77 (67)		
Former smoker	5 (28)	13 (72)		
Non-smoker	11 (44)	14 (56)		
Comorbidities				
Musculoskeletal disorders	13 (25)	38 (75)	0.34	0.4

a) p values are provided for comparison of odds ratios with 95% confidence intervals.

Among patients with recurrence, 69% experienced complications compared to 31% in the non-recurrence group, indicating a significant association (OR = 4.35, 95% CI not provided, $p = 0.000$). Panaritium was observed in one patient (100%) in the recurrence group and none in the non-recurrence group. Onychogryphosis was present in 19 recurrence patients (95%) versus one (5%) in the non-recurrence group. Abscesses occurred in only two recurrence patients (100%). All deceased patients ($n = 10$, 100%) were from the non-recurrence group (OR = 0.000, $p = 0.999$). The association between complications and recurrence was statistically significant ($p < 0.05$).

Discussion

This study investigated key demographic and lifestyle factors associated with ingrown toenail recurrence following surgical treatment, including complete or partial nail avulsion with partial matrixectomy. Global recurrence rates were 20% for wedge resection alone, compared with 11% for chemical ablation [6]. According to our study, the recurrence of ingrown toenails after complete or partial nail removal, without simultaneous matrixectomy, can be observed in as much as 70% of instances, highlighting the need to recognise and address key factors influencing recurrence rates.

In our study, we observed a 34% recurrence rate (54 cases), which is higher than reported in several other studies. For instance, research indicates that surgical procedures for ingrown toenails, such as partial nail avulsion combined with phenolisation, have recurrence rates ranging from 5% to 10% [7, 8]. For instance, a study found recurrence rates of 21% and 24%, respectively, over a 13-month follow-up period [9]. Additionally, marginal toenail ablation without chemical agents showed a recurrence rate of 10.7% [10].

In our study, complications were 31% higher in patients with recurrence, mostly due to panaritium, nail horn,

abscess and claw formation. Similarly, Ko & Lipner emphasised the significance of a nail horn [11]. In contrast, Bennett identified the role of abscesses and localised infections, such as paronychia [12] as potential factors disrupting the healing process and thereby increasing the recurrence rate. Our study provides valuable insights for healthcare policymakers, enabling the development of targeted monitoring protocols to improve patient outcomes.

We showed that being female was associated with a higher incidence than being male. Similarly, Pico et al. reported a notably higher prevalence of recurrence of onychocryptosis in females (57.8%; $p = 0.016$) [13]. Additionally, Cho et al. found a higher percentage of female (53%) than male (46.2%) patients in their study [8]. Recurrence in women is mainly due to oestrogen decline with ageing and menopause, which weakens nail structure and increases the risk of ingrown nails [14]. Studies suggest that recurrence rates may be influenced by a combination of extrinsic and intrinsic factors. Extrinsic factors include improper footwear (observed in 46% of recurrent cases) and incorrect nail-trimming techniques (74%), whereas intrinsic factors comprise nail anatomy, physiological variations and obesity (34.1%) [15].

Furthermore, our study found age-related differences in ingrown toenail recurrence, with middle-aged adults (20-51 years) showing higher rates (60-64%) than older adults (60-90 years) (0-38%). Similarly, a recent study found a higher risk of recurrence in patients aged < 40 years, suggesting that age-related factors may play an important role [16]. Contrarily, Kayalar et al. reported no correlation between age and recurrence, possibly due to cultural differences in footwear and activity, as well as individual factors such as foot care and nail-cutting habits [17].

Our analysis highlighted a high number of smokers, which may reflect our catchment demographics. In Copenhagen, 19% of residents smoke, which is slightly above the mean national rate in Denmark (16.2%), which remains higher than those of neighbouring countries such as Sweden, Iceland and Finland [18, 19]. Interestingly, our analysis revealed that being a smoker was associated with lower odds of ingrown toenail recurrence ($p = 0.016$). However, Akdeniz et al. suggested that smoking could indirectly increase recurrence risk due to significantly prolonged healing times and higher complication rates in smokers [6]. Similarly, Álvarez-Jiménez & Córdoba-Fernández emphasised smoking as a key factor impairing wound healing, markedly delaying recovery in smokers compared with non-smokers ($p < 0.0001$) [20]. Literature shows that smokers with ingrown nails face higher risks of necrosis, delayed healing and even amputation in vascular disease, with smoking raising the risk of foot surgery complications by up to 4.3-fold [19]. Differences in study design and patient demographics, and confounding factors such as post-operative care, follow-up and lifestyle variables may influence the observed link between smoking and recurrence of ingrown toenails.

This study highlights demographic and lifestyle factors - age, gender, footwear, nail-cutting habits, and anatomy - that influence ingrown toenail recurrence after nail removal without matrixectomy. This study has several limitations, including sample representativeness, surgical variation, recall bias and a relatively short follow-up period. Furthermore, the reported 34% recurrence rate is likely underestimated, as it only accounts for patients who attended follow-up visits, excluding those who sought care elsewhere or remained undiagnosed. The high proportion of smokers may also limit generalisability. While matrixectomy is the main treatment, recognising risk factors is essential to guide follow-up, adjunct use and patient counselling for better outcomes. Future studies should assess whether patient stratification by risk factors can optimise treatment strategies, compare surgical methods and explore hormonal and inflammatory influences on recurrence in high-risk groups like smokers. In addition, future studies should validate the proposed classification in independent cohorts and determine whether it can predict outcomes or support treatment decisions.

Conclusions

This study identified key demographic and lifestyle factors linked to ingrown toenail recurrence after nail removal without matrixectomy. Recurrence was associated with gender, age, footwear, nail-cutting habits and anatomy, with higher rates being observed in females and younger individuals. Smoking showed a paradoxical link to lower recurrence, possibly due to confounders. An emphasis on patient education, postoperative care and refined surgical methods may help reduce recurrence. Future studies should explore surgical comparisons, long-term outcomes and hormonal or inflammatory influences.

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