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Long-Term Outcomes of Surgical and Chemical Matricectomy for Ingrown Toenail Management: A Retrospective Study

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ABSTRACT

Introduction: Matricectomy is an effective treatment method for ingrown toenails.

Objectives: This study aimed to evaluate the outcomes of matricectomy procedures for ingrown toenails at a dermatology clinic, focusing on patient characteristics, recurrence rates, post-operative complications, and patient satisfaction.

Methods: Patient records from 2009 to 2023 for those undergoing surgical or chemical matricectomy for ingrown toenails in the dermatological surgery unit were retrospectively reviewed.

Results: The study analyzed 300 matricectomies performed on 164 patients. Chemical matricectomy was performed on 97.6% (160 patients), while 2.4% (4 patients) underwent surgical matricectomy alone, and 20.7% (34 patients) received both surgical and chemical matricectomy. Healing times and prolonged pain showed no significant differences between surgical, sodium hydroxide, and phenol matricectomy. No significant relationship was identified between side effect development and factors such as diabetes mellitus, previous nail procedures, or the type of matricectomy (surgical, phenol, or sodium hydroxide). Recurrence rates ranked from lowest to highest as follows: combined surgical and chemical, sodium hydroxide, and phenol matricectomy; however, these differences were not statistically significant.

Conclusions: No significant difference was observed in recurrence rates, side effects, or patient satisfaction between surgical, sodium hydroxide, and phenol matricectomy procedures.

Introduction

Ingrown toenail, or onychocryptosis, is a painful condition that significantly impacts an individual's quality of life. This condition occurs when the nail plate grows into the periungual skin, accounting for approximately 20% of foot-related visits to family physicians [1]. It most commonly affects the lateral side of the big toenail, with a prevalence of 2.5% to 5% in the general population [2,3]. Contributing factors include trauma, improper nail cutting, hyperhidrosis, inappropriate footwear, congenital hypertrophic periungual folds, diabetes mellitus (DM), and obesity [4,5]. Ingrown toenails are classified into stages based on severity. The first stage (mild) is characterized by pain upon touch, redness, and swelling. The second stage (moderate) includes seropurulent discharge and infection. The third stage (severe) is marked by granulation tissue formation and hypertrophy of the nail fold [6]. Conservative treatments like cotton placement and toenail braces are effective for non-severe ingrown toenails. For recurrent and severe cases, treatment options include chemical matricectomy, surgery, electrocautery, cryosurgery, and CO_2 laser matricectomy. Chemical matricectomy involves the use of active agents such as phenol, sodium hydroxide (NaOH), trichloroacetic acid (TCA), or silver nitrate [6]. Phenol and NaOH are the most commonly used agents, with phenol causing coagulation necrosis and NaOH inducing liquefaction necrosis [7]. Although phenol is the gold standard for chemical matricectomy, its drawbacks include toxicity and unsuitability during pregnancy [8,9]. The typical concentration used for phenol in matricectomy is 88%, while NaOH is used at a 10% concentration [4,7]. Studies have explored various application durations. NaOH is neutralized with acetic acid post-application, while phenol is diluted with alcohol as it cannot be fully neutralized [10].

Objectives

This study aimed to compare the outcomes of phenol, NaOH, and surgical matricectomy procedures.

Methods

This study included patients treated for ingrown toenails at the Department of Dermatology and Venereal Diseases, Ege University Medical Faculty, between 2009 and 2023. These patients underwent either surgical or chemical matricectomy (using phenol or NaOH) in the dermatological surgery unit. Surgical procedures involved wedge resection for patients treated surgically alone, while combined therapy with chemical cauterization included curettage. Before the procedure, patients were prescribed topical treatments such as antiseptics, fusidic acid, or mupirocin cream for one week, if suspected infection was present. After the procedure, patients were prescribed oral amoxicillin and clavulanic acid, along with topical antiseptics. All patients were scheduled for follow-up visits after the matricectomy. Demographic data, ingrown toenail stage before the procedure, procedure type, side effects, and recurrence rates were retrospectively analyzed from patient records. Post-procedure satisfaction was assessed through telephone interviews. The study was approved by the Local Ethics Committee protocol no: 23-8T/27. IBM SPSS Statistics 25.0 (IBM Corp; Armonk, NY) was used for data analysis. The normality of numerical variables was examined using the Shapiro-Wilk test (for $N<50$) and the Kolmogorov-Smirnov test (for $N\geq50$). Numerical variables are expressed as mean ± standard deviation and median (range). The Mann-Whitney U test was used to compare numerical variables that did not follow a normal distribution. Categorical variables are presented as counts and percentages. Relationships between categorical variables were analyzed using the Pearson Chi-squared test or Fisher's exact test, as appropriate. A significance level of 0.05 was considered for all hypotheses.

Results

The study analyzed 300 matricectomies performed on 164 patients. Of these patients, 53% were female, with a mean age of 31±15.5 (10-85) years. The mean duration of ingrown toenails was 4.7±5.9 years (range: 0.08–30). Comorbidities were present in 30 patients (18.3%), including DM, hypertension, neurological disorders, circulatory issues, and orthopedic conditions. DM was present in four patients (2.4%). Five patients (3%) had a history of surgery on the same toenail, while another five patients (3%) had pincer nails. Of the patients with documented ingrown toenail stages, seven (4.2%) had stage 1, 52 (31.7%) had stage 2, and 76 (47.5%) had stage 3. The right foot was treated in 107 patients, the left foot in 105, and both feet in 48 (29.2%). All the matricectomies were performed on the big toe. Regarding the number of matricectomies, 72 patients (43.9%) underwent one procedure, 68 (41.5%) had two, four (2.4%) had three, and 20 (12.2%) had four procedures. Chemical matricectomy (Figure 1) was performed on 97.6 % (160) of the 164 patients; of these, 103 patients (62.8%) received NaOH monotherapy, 23 (14.0%) underwent phenol monotherapy, 32 (19.5%) were treated with surgical intervention combined with phenol, and two (1.2%) with surgical intervention combined with NaOH. Four patients (2.44%) underwent surgical matricectomy alone.

For 54 patients with available healing time data, the median healing time was 14.5 days (range: 10–90). Median healing times were as follows: 14.5 days (range: 10–42, N=36) for NaOH monotherapy, 17.5 days (range: 10–28,

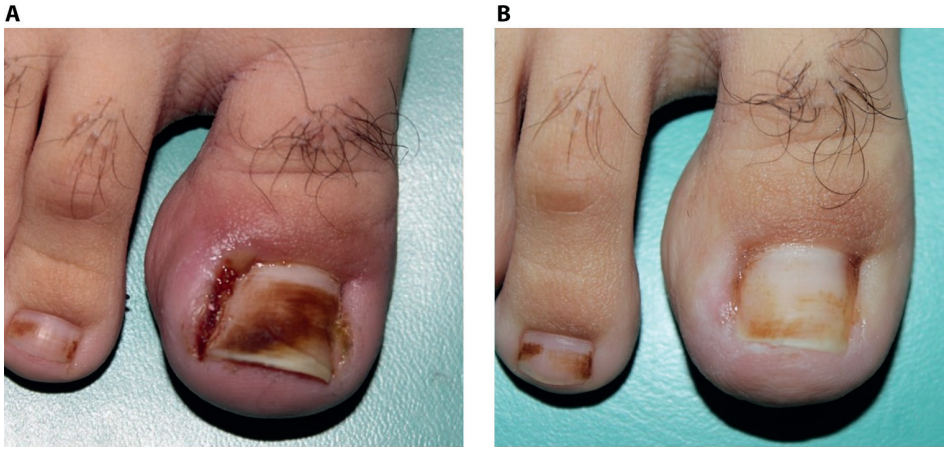

Figure 1. Appearance of the nail unit of patient who underwent NaOH matricectomy (A) before and (B) after recovery.

N=4) for phenol monotherapy, 14 days (N=2) for surgical intervention alone, 59 days (range: 28–90, N=2) for surgical intervention combined with NaOH, and 17.5 days (range: 10–30, N=10) for surgical intervention combined with phenol. However, statistical analysis showed no significant difference in healing time between NaOH monotherapy, phenol monotherapy, surgical intervention with NaOH, and surgical intervention with phenol (*P*: 0.35). Of the 55 patients with available post-procedure satisfaction data, eight (14.5%) were dissatisfied with the outcomes. Among these, seven patients (17.9%) were dissatisfied after NaOH application, and one patient (7.1%) was dissatisfied after surgical intervention with phenol. However, these differences were not statistically significant (*P*> 0.05). Of the 54 patients with available data, 10 (18.5%) reported prolonged pain: seven (12.9%) in the NaOH group, one (1.8%) in the phenol group, one (1.8%) in the surgery+phenol group, and one (1.8%) in the surgery alone group. These differences were not statistically significant (P>0.05). Of the 57 patients with available data, eight (14%) reported developing side effects. Specifically, six patients (10.5%) developed secondary infections, and two (3.5%) experienced prolonged serous discharge. No significant relationship was identified between side effect development and comorbid conditions, previous nail procedures, or the type of matricectomy performed (*P*>0.05). Of the 63 patients (116 matricectomies) with available data, recurrence occurred in 22 matricectomies (18.96%) among 17 patients. For patients with known recurrence status, the mean follow-up duration was 104 months (range: 12–196). The mean time to recurrence was 1.6±1.7 years. Recurrence rates by procedure were as follows: combined surgical and chemical matricectomy–18.8%, NaOH matricectomy–25.6%, and phenol matricectomy–33%. However, these differences were not statistically significant (*P*>0.05). No significant relationship was identified between recurrence and sex, comorbid conditions, previous nail procedures, or the type of matricectomy (*P*>0.05). Results are summarized in Table 1.

Conclusions

This study evaluated the outcomes of 300 matricectomy procedures performed on 164 patients. While previous studies often report a higher prevalence of ingrown toenails among males, others have noted a greater prevalence among females, similar to our findings [8,10-12]. A 2020 review reported that female representation in ingrown toenail treatment studies ranged from 34.4% to 90% [2]. Two different reviews reported average patient ages ranging from 13.5 to 51.2 and 16.1 to 41.4, respectively [2, 8], aligning with the mean age of 31 ± 15.5 years observed in our study. Additionally, consistent with Delgado-Miguel et al. and Yang et al., the lateral side of the big toe was the most commonly affected site [6, 13].

In this study, we analyzed 300 procedures performed on 164 patients, with recurrence data available for 116 matricectomies in 63 patients; recurrence occurred in 22 matricectomies among 17 patients (18.9%), with a mean time to recurrence of 1.6 ± 1.7 years. Recurrence rates and follow-up durations for matricectomies using chemical, surgical, electrocautery, and carbon dioxide laser methods, as reported in the literature, are summarized in Table 2. These rates range from 0% to 48.3% [3-6,10-13,14-21]. Factors such as the treatment method, practitioner experience, and follow-up duration can influence recurrence rates. While some studies did not specify follow-up periods, others reported durations ranging from three to 66 months. In our study, patients with known recurrence data had a mean follow-up duration of 104 months (range: 12–196 months). The extended follow-up in our study may have contributed to the higher recurrence rate observed. Consistent with our findings, a 2012 Cochrane analysis suggested that combining surgical and chemical matricectomy reduces recurrence risk compared to surgical matricectomy alone, particularly when phenol was used [1]. Similarly, a 2021 meta-analysis by Vinay et al. identified phenol matricectomy as having a lower

Table 1. Outcomes of Nail Matricectomy Procedures.

Category	Subcategory	Details	Results
Patient Demographics	Sex	Female	53% (87 patients)
		Male	47% (77 patients)
	Age	Mean ± SD, Range	31 ± 15.5 years (10–85 years)
	Duration of symptoms	Mean ± SD, Range	4.7 ± 5.9 years (0.08–30 years)
	Comorbidities	Patients with any comorbidity	18.3% (30 patients)
		Patients with DM	2.4% (4 patients)
	History of surgery on the same toenail	Patients with previous surgery	3% (5 patients)
	Pincer Nails	Patients with pincer nails	3% (5 patients)
	Ingrown Toenail Stages	Stage 1	4.2% (7 patients)
		Stage 2	31.7% (52 patients)
		Stage 3	47.5% (76 patients)
Procedural Characteristics	Treated Foot	Right foot	65.2% (107 patients)
		Left foot	63.4% (105 patients)
		Both feet	29.2% (48 patients)
	Number of Matricectomies	1 procedure	43.9% (72 patients)
		2 procedures	41.5% (68 patients)
		3 procedures	2.4% (4 patients)
		4 procedures	12.2% (20 patients)
	Procedure Type	NaOH monotherapy	62.8% (103 patients)
		Phenol monotherapy	14% (23 patients)
		Surgical+Phenol	19.5% (32 patients)
		Surgical+NaOH	1.2% (2 patients)
		Surgical only	2.4% (4 patients)
Healing Times	Overall	Median ± Range	14.5 days (10–90 days)
	By Procedure	NaOH monotherapy	14.5 days (10–42 days, n = 36)
		Phenol monotherapy	17.5 days (10–28 days, n = 4)
		Surgical only	14 days (n = 2)
		Surgical+NaOH	59 days (28–90 days, n = 2)
		Surgical+Phenol	17.5 days (10–30 days, n = 10)
Patient Satisfaction	Dissatisfaction Rate	Overall dissatisfaction	14.5% (8 patients)
		Dissatisfied after NaOH	17.9% (7 patients)
		Dissatisfied after Surgical+Phenol	7.1% (1 patient)
Prolonged Pain	Overall	Patients reporting prolonged pain	18.5% (10 patients)
	By Procedure	NaOH	12.9% (7 patients)
		Phenol	1.8% (1 patient)
		Surgical only	1.8% (1 patient)
		Surgical+Phenol	1.8% (1 patient)
Side Effects	Incidence	Patients reporting side effects	14% (8 patients)
		Secondary infections	10.5% (6 patients)
		Prolonged serous discharge	3.5% (2 patients)
Recurrence	Overall	Recurrence rate	18.96% (22 of 116 matricectomies)
	Time to Recurrence	Mean ± SD	1.6 ± 1.7 years
	By Procedure	Combined surgical and chemical matricectomy	18.8% (3 patients)
		NaOH monotherapy	25.6% (20 patients)
		Phenol monotherapy	33% (9 patients)

Table 2. Summary of Matricectomy Method, Number of Procedures, Recurrence Rate, and Follow-Up Periods of the Studies in the Literature [3-6, 10-13, 14-21].

Author	Matricectomy Procedure	Number of Matricectomies	Recurrence Rate (%)	Follow-Up Duration (Months)
Andreassi et al. (14)	Phenol	948	4.3	18
Ozdemir et al. (10)	NaOH	156	0	16.83±2.18 (13-20)
Romero-Pérez et al. (15)	Phenol	191	17.8	Up to 66
	Surgical	329	8.2	
Misiak et al. (3)	Phenol	30	16.67	3
	Electrocautery	30	26.67	
Bostanci et al. (4)	Phenol	350	0.57	25
Mitchell et al. (12)	Phenol	87	18.4	14
	Nail bed excision	31	22.6	
	Wedge resection	180	48.3	
	Wedge resection + phenol	344	21.2	
Córdoba-Fernández et al. (16)	Wedge resection + phenol	74	7.4	40.8 (34-51)
Barreiros et al. (17)	TCA	197	2	6
Sargin et al. (18)	Winograd	61	14.7	3
	Winograd + electrocautery	82	3.6	
Delgado-Miguel et al. (6)	Electrocautery	86	11.2	
	Silver nitrate	151	4.7	
Yang et al. (13)	Avulsion + curettage	22	19	
	Avulsion + surgical matricectomy	420	20	
	Avulsion + chemical matricectomy	112	12	
Gurhan et al. (11)	Wedge resection	96	14	12.35
	Wedge resection + electrocautery	93	9	
Farley-Sakevich et al. (19)	Co_2 Laser	381	2.1	34 (min 12)
Kim et al. (20)	Winograd + electrocautery	76	3.95	14.66 (12-25)
Kayalar et al. (21)	Winograd	480	9.8	36 (10-100)
Wang et al. (5)	Original minimal invasive method	436	1.6	>24

recurrence risk compared to other chemical matricectomies, destructive methods, and conservative treatments [8]. In addition, Ozdemir et al. reported no recurrence with chemical matricectomy using NaOH [10]. Gurhan et al. noted that adding electrocautery to wedge resection reduced recurrence in adolescents but had no significant effect in adults [11]. In a study of pediatric patients, Yang et al. found a significant reduction in recurrence risk with preoperative antibiotic use and chemical matricectomy. They noted no association between recurrence risk and factors such as sex, duration of ingrown toenail, laterality, preoperative inflammation, or anesthesia type [13]. Misiak et al. reported that the absence of comorbidities was associated with a lower recurrence risk [3]. Similarly, recurrence rates in our study were not significantly associated with comorbid conditions, previous nail procedures, or the type of matricectomy performed. Postoperative infections, the most common complication following matricectomy, have been reported in the literature with rates ranging from 0.46% to 18.9% [5,13,15,9,20,22] (Table 3). The infection rates in our study fall within this range, consistent with previously reported outcomes. Similar to our findings, Yang et al. reported no significant association between infection risk and the procedural methods [13]. Rusmir et al. attributed higher infection rates after matricectomy, compared to other clean foot and ankle surgeries, to microbial colonization on the nail fold [22]. A Cochrane review further emphasized the lack of evidence supporting routine postoperative antibiotic use to prevent infections [1]. Consistent with previous studies, phenol matricectomy appears to offer faster recovery times compared to NaOH and surgical

Table 3. Summary of Studies in the Literature Reporting Post-Operative Infection After Matricectomy [5,13,15,19,20,22].

Author	Matricectomy Procedure	N. of Matricectomies	Rate of Post-Operative Infection (%)
Rusmir et al. (22)	Excisional matricectomy	111	18.9
Yang et al. (13)	Surgical matricectomy	383	6
Farley-Sakevich et al. (19)	CO_2 laser	381	6.6
Kim et al. (20)	Winograd + matrix electrocauterization	76	2.63
Romero-Pérez et al. (15)	Surgical matricectomy	329	15.3
	Chemical matricectomy	191	2.9
Wang et al. (5)	Original minimal invasive method	436	0.46

methods, though our findings did not show a statistical significance. Misiak et al. reported faster healing with phenol matricectomy compared to electrocautery [3]. Bostanci et al. indicated a healing time ranging from two to four weeks [4].

Surgical and chemical matricectomy are both effective treatments for ingrown toenails. The recurrence rates observed in this study may have been influenced by the extended follow-up period and difficulties in reaching all patients. Factors such as non-attendance at follow-up appointments by patients without recurrence and additional treatment sought by those with recurrence could have contributed to these findings. Furthermore, shorter application times for chemical agents during matricectomy may have impacted the outcomes. Notably, our study found no significant difference in recurrence rates, side effect development, or patient satisfaction among surgical, NaOH, and phenol matricectomy procedures, underscoring the comparable efficacy of these treatment methods.

Limitations

This study is limited by missing patient data, primarily due to its retrospective design spanning 2009–2023. Incomplete documentation from earlier years and difficulties in reaching patients for post-procedure satisfaction assessments contributed to data gaps. Despite multiple attempts, some patients were unreachable due to outdated contact information. These challenges impacted the dataset for 164 patients and 300 matricectomies, potentially limiting the comprehensiveness of the analysis.

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