

Partial Matrix Excision or Segmental Phenolization for Ingrowing Toenails

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Objective: To decide whether partial nail extraction with phenolisation or with partial excision of the matrix should be the standard treatment in patients with ingrowing toenails of the hallux.

Design: Randomized clinical trial with 12-month follow-up evaluations performed by observers who did not know which procedure was applied.

Setting: Outpatient department of a surgical teaching hospital.

Patients: Fifty-eight consecutive patients with a total of 63 ingrowing toenails were randomized.

Intervention: Thirty-four partial matrix excisions (“matrix” group) and 29 phenolizations (“phenol” group) were performed.

Main Outcome Measures: Recurrence rate, postoperative morbidity (pain, wound exudates, and scar dis-

comfort), and time to complete recovery (wearing shoes, performing normal activities/work).

Results: Recurrences were seen after 7 procedures in the matrix group and also after 7 procedures in the phenol group, of which patients were symptomatic and required a second operation in 4 and 3 instances, respectively. None of the observed differences in wound healing, postoperative pain, and recovery were statistically significant.

Conclusions: Partial matrix excision and phenolization are equally effective in treating ingrowing toenails. Because the use of the toxic agent phenol should be avoided, partial matrix excision is the preferable procedure. But in view of the high recurrence rate, there is a need for further improvement of the treatment of ingrowing toenails.

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UNGUIS INCARNATUS is a common cause of pain and discomfort, causing problems with shoe-wear, performing daily activities, hobbies, and sporting activities. It often leads to patients' absence from work. An ingrowing toenail is most frequently seen at the hallux. It is ascribed to bad trimming of the nails in combination with local pressure and irritation of the shoes and poor foot hygiene.^{1,2} It results in pressure necrosis of the soft tissues, with ulceration, inflammation, and often infection.³ Granulation tissue appears on the nail wall, and the edge of the nail plate becomes “overridden” or “embedded” by the abnormal nail wall, producing the apparent ingrowth of the nail.

Different treatment methods with different outcomes have been described in the literature.

In our hospital, 2 treatment methods were in use: partial nail extraction in combination with phenolization of the matrix and partial excision of the matrix. Based on the literature, no preference for either method can be given.⁴⁻⁹ The hypothetical advantages of partial matrix excision seem to be a faster postoperative recovery and the avoidance of the use of toxic agents (phenol).¹⁰

To decide whether partial nail extraction with phenolization or partial excision of the matrix should be the standard treatment, we conducted a randomized, clinical trial in patients with ingrowing toenails of the hallux, with the

PATIENTS AND METHODS

All patients who were referred to our surgical teaching hospital with an ingrowing toenail of the hallux, who also had a combination of pain, ulceration, and inflammation (which made a surgical intervention necessary), were asked to take part in the study. Infection did occur often, but this was not a necessary inclusion criterion. Infection was defined as the presence of purulent exudate. Patients with diabetes mellitus, a life expectancy of less than 1 year, involvement of both nail folds of 1 hallux, and a recurrent ingrowing toenail were excluded. In patients with absent crural pulsations, an ankle-brachial index was recorded. Patients were excluded from the study when this index was below 0.95. Patients with bilateral involvement underwent a second procedure at the other foot only after full recovery of the first procedure.

The institutional review board approved the protocol. After we obtained informed consent, patients were randomly allocated into 1 of the 2 treatment groups, using prearranged sealed envelopes as designed by our independent statistician (J.H.).

All treatments were performed using ring block anesthesia with 1% lidocaine hydrochloride. All patients were treated by residents under the direct supervision of 2 experienced surgeons (R.H.G. and R.J.D.) (17 procedures) or by these 2 surgeons themselves (46 procedures). The residents and the surgeons were randomly allocated to the procedures.

PARTIAL NAIL EXTRACTION WITH PHENOLIZATION OF THE MATRIX (PHENOL GROUP)

The technique used was described by Ross¹¹ in 1969 and is also called angular phenolization. The toe was iodized, the local anesthesia was inserted at the base of the toe, and thereafter, a tourniquet was applied. The nail was cut longitudinally on the affected side with a straight pair of scissors. The skin side of the eponychium was not incised. The ingrowing segment of the affected nail was removed. The corner under the eponychium was curetted until all remnants of the nail were removed. Petroleum jelly was applied to protect the surrounding skin. A cotton ball soaked in 80% phenol was applied to the nail bed underneath the nail fold for 1 minute. This was repeated once, and the residual phenol was then neutralized with 70% isopropyl alcohol.

PARTIAL NAIL EXTRACTION WITH PARTIAL MATRIX EXCISION (MATRIX GROUP)

Partial nail extraction with matrix excision has been described by Quénu,¹² Heifetz,¹³ and Fowler.² The segment of ingrowing nail was removed as described above. After this, a transverse incision was made in the nail bed, through the germinal matrix, down to the periosteum. This incision was lengthened perpendicular to the first one, to the side of the nail underneath the eponychium. The skin side of the eponychium itself was not incised. Subsequently, an envelope with the dorsal and ventral matrix was excised. It was macroscopically verified that this envelope was complete.

After the above-described procedures, the wound was dressed with a standard bandage (a paraffin gauze and a pressure bandage). After half an hour, the patient was weightbearing and mobilized.

STUDY PARAMETERS

Preoperatively, the history, medication, smoking habits, daily activities, and symptoms of each patient were noted. Patients were examined on a regular basis by protocol after 2 and 8 days, and after 1, 3, and 12 months. The protocol allowed for additional examinations in case of a recurrence of symptoms. These examinations were done by independent observers, who had no knowledge of the procedure that had been carried out. The wound was checked for erythema, purulent exudate, and recurrence. Recurrence was defined as evidence of ingrowth of the nail edge or spicule formation. Patients without pain or discomfort, but with signs of spicule formation, were considered patients with a recurrence, as the presence of the spicule is a sign that some of the germinal matrix was left at the time of operation. Only in patients with disabling complaints was a second procedure carried out. Patient symptoms were noted, as was the time it took to wear shoes and perform daily activities such as work, hobbies, and sports without pain or discomfort. Pain at night and during the day, discomfort of the scar, relief of symptoms, and the satisfaction of the patient with the cosmetic outcome were scored by the patient on a visual analogue scale (0-10, not present or very satisfactory to heavy presence or very unsatisfactory).

SAMPLE SIZE, DATA MANAGEMENT, AND STATISTICS

It was expected that both methods had the same recurrence rate. The main evaluation parameter was the time to complete recovery. This was expected to be, on the average, 10 days for the partial matrix excision treatment and 14 days for the segmental phenolization treatment. The standard deviations were expected to be 4 days in each group. To detect this difference of 4 days for the means, 22 patients from each group were needed (when testing is done with a level of significance of $P = .05$ [2-sided] and a power of 0.90). All these expectations were based on a pilot study we did prior to this study.

To compare the 2 treatment groups, the t test for independent samples was used for quantitative parameters. Results were checked with the Mann-Whitney test in view of the nonnormality (skewness) of some parameters. Both tests gave similar results (not reported).

Binary variables (2×2 tables) were analyzed with the χ^2 test or Fisher exact test (in case of low cell counts). Kaplan-Meier curves for the relapse risk were made and compared with the log-rank test. Because of the number of statistical tests performed, a reduced level for the P value of less than .01 was considered significant.

NUMBER OF PATIENTS AND PREINTERVENTION CHARACTERISTICS

From July 1996 until April 1997, 60 patients were enrolled in this study. Two patients (both from the phenol group) withdrew from the study because of personal reasons. Of the remaining 58 patients, 5 were treated bilaterally; so 63 total procedures were performed. Consequently, this leaves 34 ingrowing toenails in the matrix group and 29 in the phenol group (**Figure 1**). The evaluation was oriented to each procedure separately, so we concentrated the evaluation of the outcomes on 63 procedures (**Table 1**).

Continued on next page

In 32 cases, the right side was affected; and in 31, the left. There were no significant differences among the study groups in patient characteristics. Also, the preoperative visual analogue scale scores for pain during day and night were comparable in both groups (**Table 2**). There was no difference in operation time between matrix excision and phenolization. The mean surgical duration was 13.3 minutes (range, 5-20 minutes) for matrix excision and 12.1 minutes (range, 7-15 minutes) for phenolization. There were no patients lost to follow-up.

follow-up evaluations performed by observers, who were blinded as to which procedure was applied.

RESULTS

RECURRENCES

In 7 procedures in the matrix group and also in 7 procedures in the phenol group, a recurrent ingrowing toenail was seen. The recurrence was seen after a mean of 7.7 months (range, 5-12) in the matrix group and after 9.6 months (range, 4-13) months in the phenol group (**Table 3**). The Kaplan-Meier curves for the recurrence

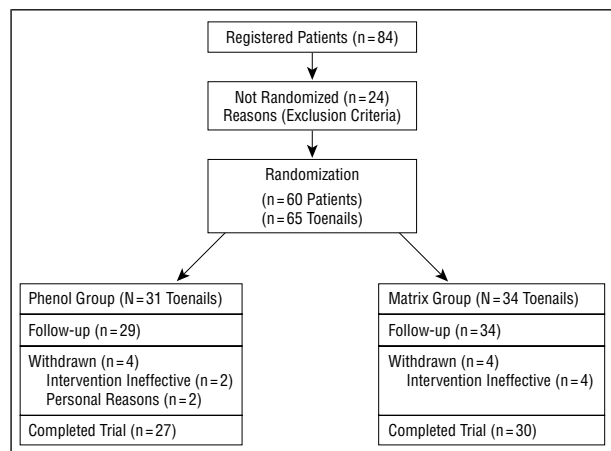


Figure 1. Profile of randomized controlled trial of partial matrix excision or segmental phenolization of ingrowing toenails.

risk are shown in **Figure 2**. In 4 of these recurrence patients in the matrix group (4/34) and in 3 in the phenol group (3/29), a second procedure had to be performed because of recurrence of disabling symptoms.

POSTOPERATIVE MORBIDITY

There was a tendency in the matrix group to have less postoperative pain (**Table 2**), a shorter period with erythema and purulent exudates (**Table 4**), less discomfort of the scar, and fewer persisting symptoms after 4 weeks. Neither intervention technique had an advantage in the area of cosmetic result (**Table 5**).

TIME TO COMPLETE RECOVERY

The groups showed no significant difference in problems with shoe wear or performing work, hobbies, and sporting activities (**Table 6**). Patients in the matrix group were able to wear their shoes without problems after a median of 4 days (range, 2-60 days). In the phenol group, the median was 3 days (range, 1-270 days). Patients in the matrix group were able to return to their daily work without problems after a median of 3.5 days

Table 1. Characteristics for the 63 Procedures*

	Matrix Group	Phenol Group	Total
Toenails treated	34	29	63
Toenails at risk after 3 mo†	34	29	63
Second procedures between 3 and 12 mo	4	2 (+1)‡	
Toenails at risk after 12 mo†	30	27	57
Mean age (range), y	22.7 (9-56)	24.4 (12-76)	
Sex (M/F)	15/19	15/14	
Affected side			
Right	17	15	
Left	17	14	
Smoking	6	6	
Erythema	24	22	
Purulent exudates	8	11	
Hypergranulation tissue	24	21	
Ulcer	6	7	

*Data are presented as number of patients except where indicated.

†Patients available for follow-up without a second procedure.

‡+1 indicates that a second procedure was performed for 1 patient after 13 months.

Table 2. Pain During the Day and at Night on Visual Analogue Scale*

Follow-up	Daytime Pain Score			Nighttime Pain Score		
	Matrix (N = 34)	Phenol (N = 29)	P Value	Matrix (N = 34)	Phenol (N = 29)	P Value
Preoperative	5.9 (2.4)	5.9 (2.4)	.98	4.4 (3.1)	3.4 (3.0)	.21
2 Days	3.8 (2.5)	3.8 (2.7)	.99	2.6 (2.2)	3.0 (2.7)	.58
8 Days	1.9 (1.4)	2.3 (1.8)	.41	1.4 (1.3)	1.9 (2.2)	.24
1 Month	1.2 (0.6)	1.6 (1.6)	.16	1.0 (0.2)	1.3 (0.9)	.13
3 Months	1.8 (2.0)	1.2 (0.7)	.19	1.2 (0.8)	1.0 (0.2)	.32
12 Months†	1.2 (0.6)	1.7 (1.8)	.10	1.0 (0.2)	1.0 (0.0)	.36

*All data are presented as mean (SD). P values were determined by a 2-sample t test.

†Number of procedures at risk in the matrix and phenol groups was 30 and 27, respectively.

(range, 1-14 days); and in the phenol group, after a median of 3.5 days (range, 1-90 days).

COMMENT

Partial matrix excision and segmental phenolization of the matrix are comparable methods for the treatment of ingrowing toenails. The 13-month recurrence rate in our study was 21% in the matrix group and 24% in the phenol group, of which 12% and 10% needed a second procedure, respectively. Comparing the 2 techniques,

partial matrix excision consistently showed a more favorable tendency in postoperative morbidity and time to complete recovery for nearly all parameters; however, there were no significant differences.

Many different methods for treatment of an ingrowing toenail are described in the literature (**Table 7**). Nail extraction or partial nail extraction alone has a high recurrence rate, ranging between 64% and 83%.^{7,14-16} The recurrence rate of wedge resection with incision of the eponychium ranges from 10% to 30%.^{5,6,8,14,15,17,18} A disadvantage of the wedge resection is the incision of the eponychium, which may lead to prolonged healing or problems with the scar. Combining wedge resection with phenolization reduces the recurrence rate to between 0% and 4.4%.^{3,17} Partial nail extraction with segmental phenolization or partial matrix excision are less invasive com-

Table 3. Relapses and Second Procedures

Relapse, No. of Months After First Procedure	Second Procedure
Matrix procedure	
5	Yes
5	Yes
6	No
6	Yes
8	Yes
12	No
12	No
Phenol procedure	
4	No
7	Yes
9	Yes
10	No
12	No
12	No
13	Yes

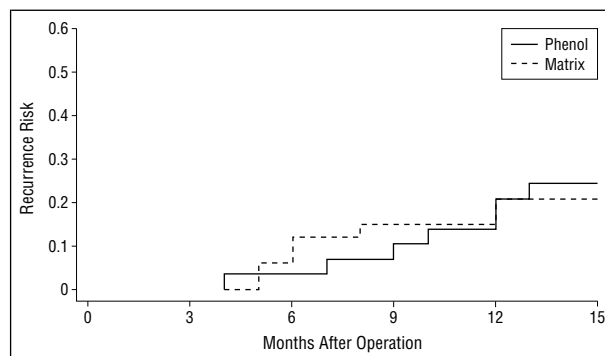


Figure 2. Risk of recurrence for ingrowth of toenail after partial matrix excision or segmental phenolization after partial nail extraction.

Table 4. Erythema and Purulent Exudates*

Follow-up	Erythema			Purulent Exudates		
	Matrix (N = 34)	Phenol (N = 29)	P Value	Matrix (N = 34)	Phenol (N = 29)	P Value
Preoperative	24 (71)	22 (76)	.78	8 (24)	11 (38)	.24
2 Days	20 (59)	15 (52)	.57	4 (12)	5 (17)	.54
8 Days	15 (44)	13 (45)	.96	6 (18)	9 (31)	.21
1 Month	5 (15)	9 (31)	.12	0 (0)	3 (10)	.09†
3 Months	1 (3)	0 (0)	1.0†	1 (3)	1 (3)	1.0†
12 Months‡	0 (0)	4 (15)	.05†	1 (3)	3 (11)	.34†

*Data are presented as number (percentage) of procedures.
 †Values were determined by Fisher exact test. All other P values are according to χ^2 test.
 ‡Number of procedures at risk in the matrix and phenol groups was 30 and 27, respectively.

Table 5. Satisfaction With Scar, Presence of Symptoms, and Cosmetic Result*

Follow-up	Scar Score			Symptoms Score			Cosmetic Score		
	Matrix (N = 34)	Phenol (N = 29)	P Value	Matrix (N = 34)	Phenol (N = 29)	P Value	Matrix (N = 34)	Phenol (N = 29)	P Value
2 Days	...	...	...	...	...	...	...	...	...
8 Days	...	...	...	...	...	...	...	...	...
1 Month	1.2 (0.4)	2.1 (2.2)	.02	1.0 (2.1)	1.8 (2.8)	.13	1.4 (2.7)	1.1 (2.1)	.55
3 Months	1.7 (1.8)	1.3 (1.0)	.37	1.1 (2.5)	1.0 (1.7)	.27	2.2 (3.2)	1.0 (2.1)	.11
12 Months†	1.3 (1.2)	1.7 (2.2)	.46	1.0 (1.4)	1.0 (2.4)	.29	1.0 (1.9)	2.0 (3.0)	.17

*Data are presented as mean (SD) score. P values were determined by a 2-sample t test. Ellipses indicate not applicable.
 †Number of procedures at risk in the matrix and phenol groups was 30 and 27, respectively.

Table 6. Problems With Shoe Wear, Work, or Daily Activities, Hobbies, or Sports*

Follow-up	Shoe Wear			Work or Daily Activities			Hobbies or Sports		
	Matrix (N = 34)	Phenol (N = 29)	P Value	Matrix (N = 34)	Phenol (N = 29)	P Value	Matrix (N = 34)	Phenol (N = 29)	P Value
Preoperative	26 (76)	19 (66)	.34	15 (44)	11 (38)	.62	21 (62)	18 (62)	.93
2 Days	34 (100)	27 (93)	.12	31 (91)	25 (86)	.80	32 (94)	25 (86)	.12
8 Days	11 (32)	12 (41)	.46	6 (18)	8 (28)	.34	13 (38)	11 (38)	.99
1 Month	3 (9)	7 (24)	.11	1 (3)	2 (7)	.60†	3 (9)	3 (10)	.83
3 Months	2 (6)	2 (7)	1.0†	0 (0)	0 (0)	1.0†	2 (6)	1 (3)	1.0†
12 Months‡	3 (10)	3 (11)	1.0†	1 (3)	1 (4)	1.0†	1 (3)	0 (0)	.62†

*Data are presented as number (percentage) of procedures.

†Values were determined by Fisher exact test. All other P values are according to χ^2 test.

‡Number of procedures at risk in the matrix and phenol groups was 30 and 27, respectively.

Table 7. Literature Review of Ingrowing Toenails*

Procedure	No. of Patients in Study	Mean No. of Months Until Follow-up	No. of Patients Lost to Follow-up	Recurrence No. of Patients (%)	Study
Nail extraction	81	12	...	59 (73)	Greig et al ⁷
	95	...	...	61 (64)	Murray and Bedi ¹⁴
	131	...	...	92 (70)	Palmer and Jones ¹⁵
	42	18	...	31 (74)	Antrum ¹⁶
Partial nail extraction	56	12	...	41 (73)	Greig et al ⁷
	29	...	...	23 (83)	Palmer and Jones ¹⁵
Partial nail extraction + phenol	280	6	2	8 (3)	Cameron ⁴
	53	6	1	4 (7)	Issa and Tanner ⁵
	54	14	...	4 (7)	Morkane et al ⁶
	67	12	...	6 (9)	Greig et al ⁷
	29	12	0	7 (24)†	Present study
Wedge excision (Winograd)	55	6	1	7 (13)	Issa and Tanner ⁵
	53	14	...	16 (30)	Morkane et al ⁶
	22	14	2	2 (10)	Schütte ⁹
	56	...	...	15 (27)	Murray and Bedi ¹⁴
	38	...	...	11 (29)	Palmer and Jones ¹⁵
	126	...	...	22 (17.5)	Fulton et al ¹⁷
	320	12	92	5 (16)	Wallace et al ¹⁸
Wedge excision + phenol	62	6	0	0 (0)	Issa and Tanner ⁵
	183	...	...	8 (4.4)	Fulton et al ¹⁷
Excision nailfold	50	18	6	10 (20)	Antrum ¹⁶
Partial matrix excision	24	14	2	0 (0)	Schütte ⁹
	528	21	119	7 (1.7)	Gabriël et al ⁹
	34	12	0	7 (21)‡	Present study
Total matrix excision (Zadik)	94	...	...	25 (27)	Murray and Bedi ¹⁴
	47	...	...	13 (28)	Palmer and Jones ¹⁵

*Ellipses indicate that the data could not be extracted from original publication.

†Patients were 10% symptomatic.

‡Patients were 12% symptomatic.

pared with wedge resection, as the eponychium is not incised. In the literature and in the present study, both techniques have the same recurrence rates.⁴⁻⁹

In this study, a few procedures were done by different residents under direct supervision of 2 of the authors (R.H.G. and R.J.D.). Because of the high recur-

rence rate in the partial matrix excision group, it is difficult, even in experienced and motivated hands, to be sure about the completeness of the envelope.

The recurrence rates in our study seem high in comparison with those found in the literature. The most likely reasons for this are that almost all previously reported

studies have a lack of standardization of the technique and/or have a short or incomplete follow-up, and/or a retrospective evaluation of the outcome, such as nonstandardized reports in the patient record.

In our prospective, randomized, observer-blinded, technique- and outcome-standardized study with a complete 1-year follow-up, 79% of the relapses were seen between 6 and 13 months of follow-up. The present study showed a tendency for faster postoperative recovery and lower postoperative morbidity in patients treated with partial matrix excision. This could be explained by the prolonged postoperative wound drainage after phenol treatment.¹⁹⁻²¹ It can take 4 to 8 weeks for the wound to heal.²² However, after 1 year, all the subjective healing parameters were completely comparable between the 2 techniques. This is probably due to the fact that the skintissue of the eponychium was not incised in both methods.

The best treatment of ingrowing toenails should meet the following requirements: it should be effective; it should be a simple, cheap, and outpatient procedure; there should be little postoperative discomfort; return to normal activities should be quick; the percentage of complications should be low; the recurrence rate should be minimal, and the outcome should be cosmetically acceptable. In this study of ingrowing toenails, partial matrix excision and segmental phenolization after partial nail extraction both seem to fit nearly all these requirements. Unfortunately, the main outcome, the recurrence rate for both methods, is too high. At present, we prefer partial matrix excision to avoid the use of the toxic agent phenol. The high recurrence rate forced us to develop further studies to improve the main outcome of the treatment of ingrowing toenails.

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