Electrocautery with partial matrixectomy in comparison with partial matrixectomy alone in treatment of ingrown toenail

Selmy Awad[a], Waleed Althobaiti[b], Saleh Alghamdi[b], Khaled Alsubaie[b], Soliman Ghedan[b], Mohamed Shetiwy[a]

[a]Department of General Surgery, Mansoura University Hospitals, Mansoura, Egypt, [b]King Faisal Medical Complex, TAIF, Saudia Arabia

Correspondence to Selmy Awad, MD, Department of General Surgery, Mansoura University Hospitals, Mansoura 35516, Egypt. Tel: +20 103 003 6362; fax: +2 050 2202834; e-mail: selmysabry2007@yahoo.com

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Background
Ingrown toenail is a frequent health problem that is commonly seen in adults and young individuals and subsequently results in significant socioeconomic outcomes. The inflammation of toenail tissue is the most prevalent manifestation. Despite the existence of different therapeutic modalities, there is no consensus on the optimal management yet.
Objective
The aim was to assess the effectiveness of electrocautery after partial matrixectomy with partial matrixectomy alone in the management of ingrown toenails.
Patients and methods
The population of ingrown toenail cases was divided into two categories, with 100 patients in each one, who had partial matrixectomy at outpatient clinic of general surgery at Mansoura University Hospitals from October 2015 to October 2018. The recruited patients of the study had follow-up observation for 180 days at an outpatient department.
Results
All eligible patients were operated and got high rate of surgical success; however, 13 cases of recurrence were noticed within the follow-up observation, including eight cases in the group of partial matrixectomy alone and five ones in the other group.
Conclusion
A great difference in the surgical outcome was noticed between these two groups, indicating that matrix electrocautery is connected with less recurrence rate vs the partial matrixectomy alone, with shortened healing time for both.

Keywords:
electrocautery, ingrowing toenail, matrixectomy

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Introduction

With an estimation of 10 000 new cases/year in the UK, ingrown toenails are a common presentation in clinical practice. Adult and young individuals are the most frequent age group of presentation, and it subsequently results in significant socioeconomic effect owing to diminished mobility, with work absenteeism. Different therapeutic modalities are available nowadays; however, there is no consensus on the optimal management. Besides, they are connected with bad aesthetic implications, improper patient satisfaction, and a considerable rate of recurrence [1].

The contradiction starts with the term of etiology: although most experts name the pathology ingrown toenail (unguis incarnatus) as the nail plate is thought to be the causative factor [2], others believe that it should be called onychocryptosis as the nail is only covered by hypertrophic lateral tissue of nail wall [3].

One of the suggested pathogeneses of ingrown toenails was pressure necrosis effect of the soft tissue surrounding the nail. The important contributing risk agents are increased nail-fold skin width, greater weight-bearing on the soft tissue of the nail sides, and repetitive rotation of the nail. The same research [4] tried to get the attention away from the nail as being the cause. They observed no significant differences in the contour of the toenails among cases and healthy individuals. They suppose that the current targeting of the nail as a causative agent is not the proper way, as the pathogenesis is different.

The primary management of an ingrown toenail is the conservative option, consisting of tight-fitting shoes

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avoidance and applying warm water baths frequently and soft compresses [5].

Surgical treatment is definitely needed in refractory conditions. Many techniques have been suggested, with most attacking the nail as being the cause. Partial nail avulsion conjoined with chemical ablative matricectomy with phenol is still the most preferable surgical approach [6].

Thommasen *et al*. [7] did a modification of the surgical techniques and used them in a large population toprove that soft tissue nail-fold resection results in surgical treatment and correction of ingrown toenail cases. Their technique gives good aesthetic outcomes with no occurrence of recurrence and considerable rates of individual satisfaction. The management is cost effective, is a simple technique, and can be done easily in any surgeon's clinic [8].

A wide variety of conservative and surgical techniques have been described for the management of ingrown toenail. The different approaches include Wedge excision, drainage of the abscess, and simple avulsion of the nail and radical resection of the nail. Phenolization after partial nail avulsion may have low rate of recurrence (0–4.4%), but the surgical approach is connected with high rate of recurrence [9].

The aim of this research was to assess the effectiveness of electrocautery after partial matrixectomy with partial matrixectomy alone in the management of ingrown toenails.

Patients and methods

The population of eligible patients of ingrown toenail was divided into two groups, including 100 patientsin each one, who underwent partial matrixectomy at the general surgery department of Mansoura University Hospitals, from October 2015 to October 2018. A fully performed assessment program was precisely structured so that a routine procedure was done for every case.

All cases were preoperatively and postoperatively examined. A total of 100 cases each in either group A or group B were randomly distributed. Group A included cases who underwent partial nail matricectomy with electrocautery application, whereas group B included cases who underwent partial nail matricectomy alone.

Ethical approval was secured from General Surgery Department Institutional Research Board, and informed consent was signed by every patient after detailed explanation of the operation, realistic expectations, and all the possible periprocedural complications.

Criteria of inclusion

The following were the inclusion criteria:

(1) Patients of 16–52 years old.
(2) History of conservative treatment failure for more than 1 year.
(3) Absence of peripheral vascular disease.

Preoperative workup

All patients were subjected to history taking, clinical examination (Fig. 1), and laboratory investigation (upon needed). Preformed record sheet for each patient was used, and patients' data were recorded (demographic data, duration of manifestations, previous management, preoperative prophylactic or therapeutic antibiotic use, return to work, postoperative complications such as wound discharge and infection, and wound care time).

Figure 1

Picture of the ingrown toenail preoperatively.

The procedures

The cases were operated as day-case surgeries under local anesthesia. If the patient was diagnosed as having infected ingrown toenail before the operation, oral antibiotic treatment for 5 days was administered with local care. The whole toe was scrubbed with povidone-iodine solution and wrapped sterilely. Anesthesia of digital nerve block was performed using 2% adrenaline-free lidocaine. Application of tourniquet was secured to get proper hemostasis adequately.

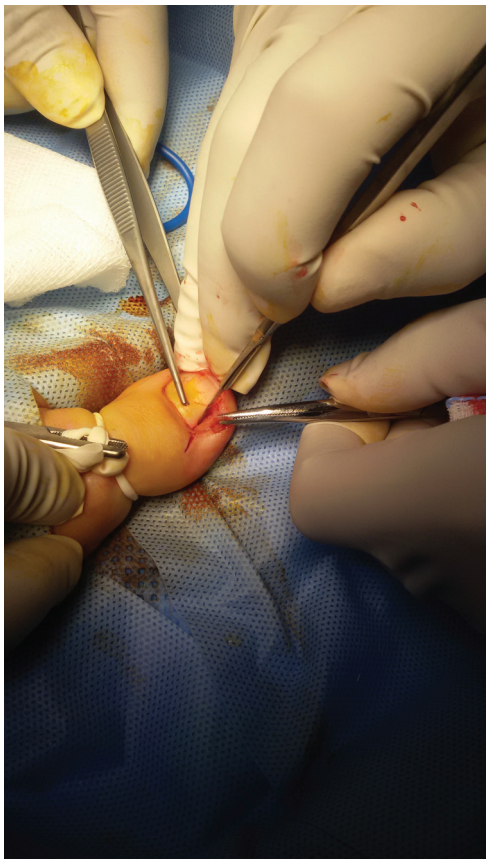
On the affected nail plate (ingrown side), approximately 7-mm longitudinal nail plate incision was done extending to 5 mm in the angle of nail skin (paronychium) with limited excision of granulation tissue and the related segmental nail matrix (Fig. 2). The skin over the nail matrix was retracted sideways and the lateral portion of the germinal matrix was partially excised followed by judicious use of shots of electrocautery (35–45 WAT) to achieve controlled meticulous matrix ablation (Fig. 3) for patients of group A and closure by 3/0 prolene sutures (Fig. 4). The tourniquet was released and the operative site was covered with sterile dressing. The same technique was performed for patients of group B without matrix ablation by electrocautery.

Postoperative care

All the cases were advised to have acetaminophen when they experienced pain, amoxicillin antibiotic 2 g orally per day for duration of 3–5 days, and antiseptic solution application for local wound care. Visual analog scale was utilized in this research as scoring system for the postoperative pain. All the relevant data were collected in preformed well-structured sheets. They included demographic personal data of the cases and signs of local examination. All postoperative cases were followed up clinically in outpatient offices on third and seventh days for pain, infection, and healing. Healing was inspected for the complete re-epithelialization of nail bad and regression of edema. After 1 and 6 months, the patients were checked for spike formation, nail edge dystrophies, recurrence, and postoperative patient satisfaction with the new general shape of their healed nails.

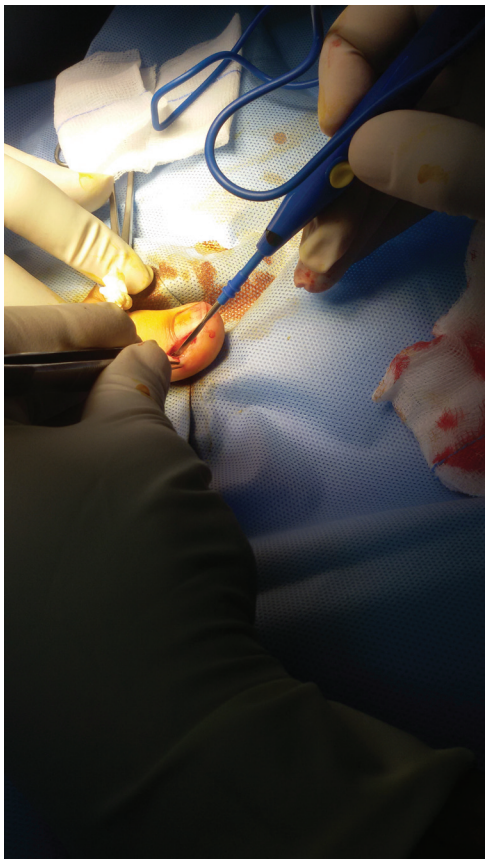
All of those data were tabulated and analyzed to check the effect of the technique on the population of the study. Cure period, recurrence rate, correlation with

Figure 2



Segmental Matrix Horn excision.

Figure 3



Matrix ablation by electrocauterization.

age, sex of cases, and comorbidities were used as variables in the analytical statistical system of IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.

Results

Preoperative data

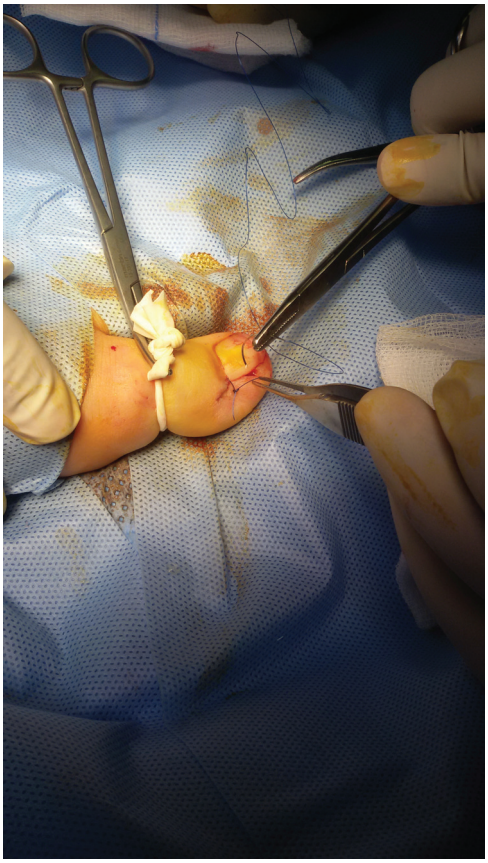
Clinical characteristics and demographic data

A total of 200 patients with ingrown toenail were treated as outpatients. The mean age at presentation was 26.45 years old (range from 16 to 52 years). The male patients represented 136 cases and the female patients were 64 cases. The male: female ratio was 2 : 1 (Table 1).

Stages of ingrown toenail

A total of 66 (33%) cases presented with stage I ingrown toenail, 38 (19%) cases presented with stage II ingrown toenail, and 96 (48%) cases presented with stage III (Table 2).

Figure 4



Wound closure using prolene suture.

Foot affection

Right foot was affected in 100 (50%) patients, and left foot was affected in 92 (46%) patients, and both feet were affected in eight (4%) patients (Table 3).

Intraoperative data

The mean time of surgery during operation was 15 ±5.6 min. We did not record any intraoperative bleeding observation in the study.

Postoperative complications

Regarding bleeding, we did not record any postoperative bleeding in the study.

(1) Regarding postoperative pain, infection, and discharge, Eight cases in group A (4%) got inflammation and infection in their folds and five cases in group B (Table 4).
(2) Regarding time of healing, all cases that presented with stage I and treated (66 cases) were cured within 10 days. The 38 cases that presented with stage II ingrown toenails and treated were cured within 12 days. The 96 cases that presented with stage III and treated were cured within 17 days. The mean time of healing was 12 days (Table 5).

Recurrence rate

Of all cases in group A,only five cases showed symptoms and signs of recurrence within 6–12 months postoperatively. There were eight cases that

Table 2 Stages of ingrown toenail

Stage	I [*n* (%)]	II [*n* (%)]	III [*n* (%)]
Number of cases	66 (33)	38 (19)	96 (48)

Table 3 Foot affection of ingrown toenail

Side	Right [*n* (%)]	Left [*n* (%)]	Both [*n* (%)]
Number of patient (100)	100 (50)	92 (46)	8 (4)

Table 1 Age and sex distribution

Sex	Count	Age ranges	Decades of life						Mean age (years)
			First	Second	Third	Fourth	Fifth	Sixth	
Male	136	17–52	0	50	54	16	14	2	27.5
Female	64	16–32	0	34	26	4	0	0	21.7
Total	200	16–52	0	84	80	20	14	2	26.45

Table 4 Post-operative complications and follow-up

Complications		Partial Nail Avulsion (*n*=200=100%)				*P*-value
	Group	Group A(*n*=100)		Group B(*n*=100)		
	Days	3rd	7th	3rd	7th	
Pain(VAS)	No	32%	44.5%	39,5%	46%	0.018
	Mild	15,5%	3%	9%	2,5%	
	Moderate	2,5%	2,5%	1,5%	1,5%	
	Severe	Nil	Nil	Nil	Nil	
Infection		1%	3%	1%	1.5%	0.029
Follow-up time		1 month	6 months	1 month	6 months	
Spike formation		Nil	Nil	Nil	1.5%	0.022
Recurrence		Nil	2.5%	Nil	4%	0.027
Mortality		None				

VAS, visual analog scale.

Table 5 Time of healing

Stage of ingrowing toenail	Number of cases (200) [*n* (%)]	Time of healing (days)	Mean time of healing (days)
Stage 1	66 (33)	10	
Stage 2	38 (19)	12	12
Stage 3	96 (48)	14	

Table 6 Recurrence rate of both groups

Recurrence	*N* (%)
Group A	5 (2.5)
Group B	8 (4)
Total	13 (6.5)

presented with symptoms and signs of recurrence in group B (recurrence rate 4%) (Table 6).

A total of 17 cases had coexisting morbidities (14 diabetes, and three mycosis of the toenail). The cases of recurrences were 13 (6.5%), with five (2.5%) patients in the group A and eight (4%) cases in the group B.

The result showed that group A and B cases had statistically similar healing time (odds ratio 4.5–95% confidence interval) (Table 7). We have found that patients of group A had lower recurrence rate than the other one.

Absence of comorbidities was noticed with a lower risk of recurrence among patients in both groups (Table 7). There was no statistically significant relationship between sex and age and the method of treatment in both groups (Tables 8 and 9).

Patient satisfaction

Aesthetic results were good in 97 cases in group A (48.5%) and 99 in group B (49.5%) who cooperated with the doctor and obey his instruction and advice on footwear and foot hygiene, especially nail trimming as the treatment regimen and was acceptable for the residual four (2%) cases.

Discussion

Ingrown toenail is a frequent health problem which has a negative effect on the quality of life and socioeconomic outcomes. The commonest sites of involvement are the big toe (the lateral border adjacent to the second toe). The pathogenesis of the disease is still not clear. The contributing risk factors in the development of this condition are sex (more prevalent in male than in female), abnormal tight-fitting shoes, nail trimming in inappropriate way especially in geriatric group of patients who have reduced ability of proper care for their feet, ischemia, infections (onychomycosis), and trauma. Plantar hyperhydrosis increases the rate of skin maceration. Hypertrophy of the nail folds plays an important role in this foot condition [7,8,10].

The most accepted theory is that ingrown toenail results from penetration of the lateral nail fold by the edge of the nail plate. The skin invaded by the nail plate has the tendency to heal itself by the production of highly vascular friable granulation tissue, which over time increases and protrudes beyond the nail plate. The damaged skin can be easily invaded by micro-organisms, which results in developing of inflammation and cellulitis [7,11–14].

Table 7 The significance of some selective parameters of two techniques of treatment

	Total [*n* (%)]	Group A [*n* (%)]	Group B [*n* (%)]	*P*
Sex				
Male	136 (68)	80 (40)	56 (28)	0,30
Female	64 (32)	20 (10)	44 (22)	
Total	200 (100)	100 (50)	100 (50)	
Comorbidities				
Diabetes	14 (7)	7 (3.5)	7 (3.5)	0,29
Mycosis	3 (1.5)	1 (0.5)	2 (1)	
None	183 (91.5)	92 (46)	91 (45.5)	
Total	200 (100)	100 (50)	100 (50)	
Recurrence				
Present	13 (6.5)	5 (2.5)	8 (4)	0,35
Absent	187 (93.5)	95 (47.5)	92 (46)	
Total	200 (100)	100 (50)	100 (50)	
Healing time				
≥12 days	104 (52)	51 (25.5)	53 (26.5)	0,02
>12 days	96 (48)	49 (24.5)	47 (23.5)	
Total	200 (100)	100 (50)	100 (50)	

Table 8 Correlation between the age of cases and the recurrence rate

	Younger [*n* (%)]	Older [*n* (%)]	*P*
Group A			
Recurrence	4 (2)	1 (0.5)	0,04
None	70 (35)	25 (12.5)	
Group B			
Recurrence	5 (2.5)	3 (1.5)	0,56
None	75 (37.5)	17 (8.5)	

Table 9 Correlation between sex of cases and the recurrence rate

	Female [*n* (%)]	Male [*n* (%)]	*P*
Group A			
Recurrence	2 (1)	3 (1.5)	0.19
Group B			
Recurrence	4 (2)	4 (2)	0.26

A wide range of modalities of surgical treatment have been used till now. Surgical technique in the management of ingrowing nail should be simple and cost effective. The different approaches differ mainly in the extension and the way of nail reduction and ablation of matrix. Surgical procedures involve partial nail or complete nail resection, with or without matrix excision [7,15]. No consensus is available as to the optimal surgical therapeutic modality of ingrown toenails. Mostly in early stages of one and two of ingrown toenails, we use the conservative techniques, and in advanced stages, the surgical procedures are preferred. In higher stages of the condition, they preferred matricectomy plus curettage [16,17]. The rate of recurrence was noticed to be high with surgeries done with no nail matrix destruction, so different modes of treatment were recognized as procedures for permanent partial nail matrix destruction using phenol-10% and trichloroacetic acid [18,19].

The debate in the treatment of ingrown toenail can be justified through some methods. The first one is the method of treatment either to be conservatively or surgically. Secondly, all the techniques mandate strict patient compliance and good experience from the treating physician side. Any therapeutic surgical modalities may be performed, either excision of the hypertrophic skin fold or narrowing of the nail plate side or both of them. The Judgement was obtained from the research studies [7,20].

In our study, we qualified patients with second and third stages in addition to failed conservative treatment of first stage. Instead of extensive surgical dissection and resection of the matrix horn, ablation can be done by narrowing of the nail or electrosurgical cauterization. Again, the target which has to be secured is that no remnants of matrix horn remain. The probable disadvantage is that traditional electrocautery delivers a considerable amount of heat that can lead to a thermal periostitis with chronic long-term postoperative discomfort and pain [4]. In our study, no cases of periostitis with chronic pain were recorded, as controlled small shots of electrocautery were used.

The rate of recurrence for different surgical modalities is between 1.7 and 29% [7]. In the current research, it was between 2.5 and 4%. The recurrence rate was related to the age of population in the research, as it was significantly higher in the young age population

than the elder one; it might be attributed to high activity of the young population. Most of the eligible cases were older than 36 years old (medium: 41.43), whereas the average age is ~30 years in many other researches. In surgical management of ingrown toenails, the recovery period of wound is known as the duration until drainage fades out and inflammatory changes end. In spite of a lack of detailed recovery data in most researches, period to go back to normal physical duties is defined as the recovery period. This period has been recorded as 2–4 weeks as a time frame of the recovery period in various studies [11,21].The present research showed significant differences statistically (P=0.02) between these two procedures in terms of the rate of recurrence. The findings revealed that in group A, the recurrence rate was significantly lower. The healing time was approximately the same in both procedures but statistically shorter than previous research studies. The result showed that the time of healing was significantly shorter and the postoperative healing processes were fast, what helped the cases to return rapidly to their daily duties.

The absolute contraindication to matrix resection is ischemia of digit, which can be a clinical symptom of systemic disease affection like diabetes or peripheral vascular diseases [18,22–24]. In our study, seventeen cases with comorbidities were recruited: fourteen cases with diabetes and three cases with fungal infection.

In this study, diabetic cases and fungal infection underwent careful examination and the Doppler US in high-risk patients of ischemia to avoid any serious complications. The results showed that absence of comorbidities was connected with lower rate of recurrence in all eligible cases (P=0.04 for group A, P=0.02 for group B).

No particular treatment was applied for any patient of fungal infections preoperatively. Our follow-up period in the present study was 6 months minimally. This period was enough to observe the rate of recurrence. Among the 200 cases, 187 cases had no recurrence, with satisfied appearance of their nails in general. Between 1 and 6 months of clinical follow-up, 13 nail recurrences were observed in the form of spicule growth. The limitations of our research were the lack of comparison with other famous technique such as phenolization, with relatively high rate of inadequate follow-up of patients.

Conclusion

Selective matrix horn excision with judicious electrocautery ablation is an effective, simple, and safe modality of management of ingrown toenails, with important statistical difference in terms of relapses and rapid healing time. Our procedure is considered as minimally invasive surgical procedure with low rates of recurrence, which may be enhanced by further more future comprehensive research studies.

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Conflicts of interest

There are no conflicts of interest.

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