

The effectiveness of matrix cauterization with trichloroacetic acid in the treatment of ingrown toenails

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ABSTRACT

Ingrown toenail is an often painful clinical condition that usually affects the big toe. Chemical matricectomy with phenol has a low recurrence rate and good cosmetic results. However, it produces extensive tissue destruction that can result in drainage and delayed healing. Alternatives such as sodium hydroxide and trichloroacetic acid (TCA) have therefore come into vogue. A total of 39 patients with 56 ingrown toenail edges underwent chemical matricectomy with 90% TCA after partial nail avulsion. In most of the patients, adverse effects such as postoperative pain and drainage were minimal. One patient who underwent matricectomy had recurrence in a single nail edge (1.8%) at 12 months follow-up. No recurrence was observed among 38 patients during the mean follow-up period. This was considered to be statistically significant ($P < 0.001$). Partial nail avulsion followed by TCA matricectomy is a safe, simple, and effective method with low rates of postoperative morbidity and high rates of success.

Key words: Ingrown toenail, matricectomy, trichloroacetic acid

INTRODUCTION

Ingrown toenail is an often painful clinical condition, which usually affects big toenails. It is a common condition of young adults. Ingrown toenails are three times more common in men than in women. The two most important causes of ingrown toenails are wearing tight shoes and toenails that are not trimmed properly.^[1,2]

Other causes include trauma, an imbalance between the nail plate and the nail bed, hyperhidrosis, abnormal walking habits, arthritis, circulatory insufficiency, obesity, onychomycosis, and subungual neoplasms.^[1,2]

Three stages are described. Stage 1 is characterized by erythema, slight edema, and pain on applying pressure over the lateral nail fold. Stage 2 is marked by symptoms of Stage 1 along with infection and drainage. Stage 3 is marked by symptoms of Stage 1 along with lateral wall thickening and granulation tissue. Conservative treatment methods are used in Stage 1 ingrown toenails. Surgical treatment methods need to be considered in recurrent cases of Stage 1, and Stage 2 and Stage 3 cases.^[3-5]

Nonselective surgical management, such as nail avulsion, wedge resection, total nail bed ablation, and soft tissue resection are usually associated with high rates of recurrence and morbidity.^[3,6,7]

Partial nail avulsion and chemical matricectomy is the most successful treatment method used for the treatment of ingrown toenails in recent years.^[2,3,7,8]

Phenol is the most commonly used agent for chemical matricectomy. Chemical matricectomy with phenol has a low recurrence rate and good cosmetic results, but it produces extensive tissue destruction and can result in drainage and a delayed healing time. Alternatives such as sodium hydroxide and trichloroacetic acid (TCA) have thus come into vogue.^[3,7,8]

Trichloroacetic acid is used for chemical peeling. TCA causes coagulative necrosis of cells through extensive protein denaturation and resultant structural cell death.^[8,9] We therefore believe that TCA can be used in place of phenol for chemical matricectomy. The objective of this study was to evaluate the effectiveness and safety of chemical matricectomy with TCA in the treatment of ingrown toenails.

Access this article online

Website: www.idoj.in

DOI: 10.4103/2229-5178.148912

Quick Response Code:



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MATERIALS AND METHODS

Patients

A total of 39 patients with 56 ingrown toenail edges were included in our study. All patients underwent chemical matricectomy with 90% TCA after partial nail avulsion. Clinical characteristics of the patients are presented in Table 1.

Appropriate systemic and topical antibiotics were administered prior to the surgical procedure for patients who were diagnosed with infection. Before the procedure, the patients were evaluated for the presence of peripheral vascular disease, uncontrolled diabetes mellitus, hemorrhagic diathesis, hypersensitivity to chemical solutions and serious systemic disease.

Surgical technique

Digital anesthesia with epinephrine-free 1% lidocaine was performed after cleaning the site of operation with the povidone-iodine solution. A tourniquet was applied proximal to the big toe. By using septum elevators, the ingrown nail was lifted off the nail bed by starting at the edge. The nail was cut longitudinally 3-4 mm away from the ingrown portion, and extracted. Ninety percent TCA was applied with a cotton tipped applicator to the matrix of extracted part and rubbed into the nail bed. TCA application was performed two times for two minutes each (a total of 4 min). The site of operation was thereafter flushed with isotonic saline solution in order to neutralize the effect of TCA. The tourniquet was removed, and antibiotic containing ointment was applied. A gauze bandage was wrapped around the nail.

Postoperative care

All patients were followed-up at two-day intervals for one week post surgery. Weekly follow-ups were continued until complete healing of the wound. Postoperative complications

including pain, drainage and infection were evaluated during postoperative follow-ups. After complete wound healing, the patients were scheduled for follow-up visits every three months. During the follow-up period, recurrence rate and cosmetic results were evaluated in order to determine the effectiveness of surgical treatment. Recurrence was defined as evidence of ingrowth of the nail edge or spicule formation.

When evaluating the results from the study, Number Cruncher Statistical System 2007 and PASS 2008 Statistical Software (Utah, USA) was used for statistical analyses. While evaluating data from the study, Student's *t*-test was used for comparisons of quantitative data, in addition to descriptive statistical methods. Chi-square test and Fisher's exact test were used for comparisons of qualitative data. Statistical significance was defined as $P < 0.05$.

RESULTS

The mean age of the patients was 27.94 ± 13.13 (1-66). Of the 39 patients, 18 (46.2%) were male and 21 (53.8%) female. Twenty-two patients (56.4%) had a single ingrown toenail, while 17 had two ingrown toenails. The mean follow-up duration of patients was 11.28 ± 6.19 months (6-24 months). Of the 56 ingrown toenails, 47 (84%) were defined as Stage 2, 7 (12.5%) as Stage 1 and 2 (3.5%) as Stage 3.

Adverse effects such as postoperative pain and drainage were minimal in most of the patients. Although 12 of the patients (30.8%) had mild pain, 5 (12.8%) had moderate pain; 22 patients (56.4%) experienced no pain. Postoperative drainage improved within 10 days in 36 of the patients (92.3%) and within 15 days in 3 of the patients. None of the patients had postoperative infection.

One patient who underwent matricectomy had recurrence in a single nail edge (1.8%) at 12 months follow-up. No recurrence was observed among 38 patients during the follow-up period. ($P < 0.001$). None of the patients complained about cosmetic results. Figures 1-4 show pretreatment and 12 months posttreatment photographs of a patient with ingrown toenail. Figure 2 shows surgical procedure and also Figure 3 indicates trichloroacetic acid application.

DISCUSSION

There is no consensus on the choice of treatment for ingrown toenails. Partial or total nail avulsion is commonly used as a conventional treatment modality, however these procedures have resulted in higher rates of recurrence (42-83%) because destruction of the germinal matrix has not been achieved.^[3,10,11] The recurrence rate in wedge resection ranges between 3-33%.^[3,12,13] Excision of the proximolateral matrix segment has a 4% recurrence rate.^[14] The latter two procedures are

Table 1: Clinical characteristics of the patients

Clinical characteristics	Number of patients (%)
Number of patients	39
Ingrown nail edges	56
Gender (%)	
Male	18 (46.2)
Female	21 (53.8)
Age	27.91 ± 13.13
Duration of follow-up	11.28 ± 6.19
Stage (%)	
Stage 1	7 (12.5)
Stage 2	47 (84)
Stage 3	2 (3.5)
Affected nail edge (%)	
Lateral	22 (39.3)
Medial	34 (60.7)



Figure 1: Pretreatment image of a patient with ingrown toenail



Figure 2: Surgical procedure

difficult surgical techniques with postoperative complications including prolonged healing time, considerable pain, and frequent infections.^[5] The Zadik's procedure has recurrence rates ranging from 14-28%, and postoperative pain, time off from work or school, and poor cosmetic results are the disadvantages.^[10,15,16]

Selective matrixectomy must minimize damage to the surrounding normal skin and soft tissue in order to shorten healing time and obtain a satisfactory cosmetic result.

There are two major methods in selective matrixectomy: mechanical and chemical. Surgical matrixectomy has a low recurrence rate, but technical difficulties, the length of time required, postoperative pain, and prolonged drainage limit the use of this technique. Several authors have reported the use of carbon dioxide (CO₂) laser for performing selective matrixectomy.^[6,17-19] The CO₂ laser achieves more selective destruction of the nail matrix than chemical matrixectomy, but has disadvantages such as technical difficulty, in addition to requiring prolonged healing time and achieving a poor cosmetic outcome.^[17,19]

The ideal surgical method for the treatment of ingrown toenails should have such features as applicable under local anesthesia, technically easy to perform, rapid healing with minimal

postoperative morbidity, and a high success rate. Chemical matrixectomy is one of the ideal methods that meet all these criteria and produce perfect results. Chemical matrixectomy following partial nail avulsion is known to be a successful and safe surgical therapeutic option for the treatment of ingrowing nails.^[3,7] Chemical matrixectomy, which was first introduced in 1945 by Boll, is a widely used method since then.^[20] The objective of treatment is to chemically destroy the lateral matrix horn in order to prevent the lateral nail plate growing into the lateral nail fold in the future.

In general, phenol and sodium hydroxide are used in chemical matrixectomy.^[3,7,20] Phenol is an effective protein denaturant. Phenol cauterizes by producing a coagulation necrosis in the matrix and surrounding soft tissues. It has antibacterial and local anesthetic effects that offer additional advantage.^[2] Phenol matrixectomy has been the choice of treatment for many investigators with high success rates (91-100%) for years.^[2,20] However, the disadvantages of performing this procedure include unpredictable tissue damage due to chemical burn caused by phenol, excessive drainage, persistent infection and extended healing times.^[8,20] Following phenol application, abdominal pain, dizziness, hemoglobinuria, cyanosis, and occasionally severe systemic reactions such as cardiac arrhythmia may occur in addition to local side effects.^[8,21]

In recent years, matricectomy with sodium hydroxide has been found to be as effective as phenol matricectomy, with shorter healing periods and a lower risk of local or systemic toxicity.^[3,7,8,20] Sodium hydroxide causes less alkali burns and liquefaction necrosis, resulting in less postoperative drainage and faster healing. However prolonged application of strong alkali can cause excessive damage due to slowly progressing liquefaction necrosis.^[22]

Trichloroacetic acid is one of the most commonly used agents for chemical peeling. Depending on the concentration, it achieves superficial to medium depth chemical peeling. TCA is a caustic chemical agent that causes coagulation necrosis, like phenol. It produces both epidermal and dermal necrosis and then neutralizes by itself without serious systemic toxicity. In a recent study, Kim *et al.* performed chemical matricectomy with 100% TCA in 25 patients with ingrowing toenail edges, and reported that the success rate was 95%.^[8] They reported that adverse effects such as postoperative pain, drainage and infection were mild; postoperative drainage generally decreased within one week and did not last more than two weeks.^[8] In a study by Aksakal *et al.*, the authors have reported that the pain after phenol matricectomy lasted about one week and postoperative drainage lasted for 11-42 days.^[23]



Figure 3: Trichloroacetic acid application

In our study, adverse effects such as postoperative pain and drainage were minimal in the majority of patients. While 12 of the patients (30.8%) had mild pain, 5 (12.8%) had moderate pain; 22 (56.4%) experienced no pain. Postoperative drainage improved within 10 days in 36 patients (92.3%) and within 15 days in 3 patients. None of the patients had postoperative infection. Furthermore, none of the patients had spicule formation.

Bostanci *et al.*, during a mean patient follow-up period of 14 months found success rates of 95.1% with sodium hydroxide matricectomy and 95.8% with phenol matricectomy. They reported that recurrences occurred within 10 months after treatment.^[20] In our study, the success rate of treatment was found to be 98.2%. One patient who underwent matricectomy had recurrence at 12 months. In our study, 90% TCA matricectomy showed treatment success comparable to those of phenol and sodium hydroxide matricectomy. In our previous studies, we observed higher recurrence (6-11%) and complication rates (6-8%) with phenol matricectomy [Table 2].^[24,25]

Partial nail avulsion followed by TCA matricectomy is a safe, simple, and effective method with low rates of postoperative morbidity and high rates of success. Therefore, partial nail avulsion and TCA matricectomy can be used as an alternative treatment method for the treatment of ingrowing toenails.

Table 2: Comparative profile of TCA versus phenol

Post-operative findings	TCA	Phenol
Complication rate	Lower	Higher
Recurrence rate	Lower	Higher
Spicule formation	Lower	Higher

TCA: Trichloroacetic acid



Figure 4: Twelve months post treatment image of the same patient

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Cite this article as: Terzi E, Guvenc U, Türsen B, Kaya TI, Erdem T, Türsen Ü. The effectiveness of matrix cauterization with trichloroacetic acid in the treatment of ingrown toenails. *Indian Dermatol Online J* 2015;6:4-8.

Source of Support: Nil, **Conflict of Interest:** None declared.