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Formic Acid Matricectomy in The Treatment of Ingrowning Toenails

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Abstract

Motivation/Background: Partial nail plate avulsion and chemical matricectomy is the most successful method for the treatment of ingrown toenails. Phenol, sodium hydroxide and trichloroacetic acid(TCA) were used for chemical matricectomy. The aim of our study was to evaluate the efficacy and safety of formic acid matricectomy in the treatment of ingrown toenails.

Method: Twenty-five patients with 44 ingrowing nail sides were treated with formic acid.Formic acid matricectomy with 85% formic acid after partial nail avulsion was performed. Patients were evaluated at 48 hours and afterward weekly until full wound healing was achieved for the severity of postoperative complication.All patients were followed up for the recurrence rate and effectiveness of treatment.

Results: No recurrence was observed 25 patients during mean follow-up period.While 8 of the patients had mild pain, 4 moderate pain and 2 severe pain;11 patients experienced no pain. Postoperative infection was occured 3 patients (12%). Postoperative drainage improved within 15 days in 21 patients (84%), within one month in 2 patient (8%). Postoperative drainage improved more than one month in 2 patient (8%).

Conclusion: Due to formic acid matricectomy has severe postoperative infection and delaying postoperative healing time,other matricectomy modalities should be preferred.

Keywords: Formic Acid; Chemical Matricectomy; Ingrown Toenails; Postoperative

Abbreviations: TCA: Trichloroacetic Acid; NCSS: Number Cruncher Statistical System; CO_2: Carbon Dioxide

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 3 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. Other causes include trauma, an imbalance between the nail plate and the nail bed, hyperhidrosis, abnormal walking habits, arthritis, circulatory insufficiency, obesity,

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onychomycosis treatment and subungual neoplasms [1-2].

Ingrown toenails are reviewed in 3 stages. Stage 1 ingrown toenails are characterized by erythema, slight edema, and pain with pressure to the lateral nail fold. Stage 2 is marked by increased symptoms of stage 1 as well as drainage and infection. Stage 3 ingrown toenails display magnified symptoms of stage 1 accompanied by lateral wall thickening and granulation tissue. Conservative treatment methods are used in stage 1 ingrown toenails. Surgical treatment methods should be used in recurrent stage 1 ingrown toenails, and in stage 2 and stage 3 cases [3-5]. Nonselective surgical management, such as nail avulsion, wedge resection, total nail bed ablation, 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 management 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. These adverse effects have brought forward the use of chemical agents such as sodium hydroxide and trichloroacetic acid (TCA) for matricectomy [3,7,8]. Formic acid 85% is used in the treatment of common viral warts [9-10]. We believe that formic acid can be used in the chemical matricectomy. The objective of this study was evaluated the effectiveness and safety of chemical matricectomy with formic acid in the treatment of ingrown toenails.

Materials and Methods

Patients

Twenty-five patients with 44 ingrown toenail edges were included in our study. All of the patients underwent chemical matricectomy with 85% formic after partial nail avulsion. Clinical characteristics of the patients are presented in Table 1.

Appropriate systemic and topical antibiotics were administered to patients who were diagnosed with infection before surgical procedure. 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 diseases.

Number Of Patients	25
Ingrowıng Nail Edges	44
Gender	
Male	11(44%)
Female	14(56%)
Age	36.96 ± 6.43
Duratıon Of Follow-Up	16.23 ± 5.33
Stage	
Stage 1	9(20.4 %)
Stage 2	15(34.1 %)
Stage 3	20(45.5)
Affected Naıl Edge	
Lateral	22(50%)
Medial	22(50%)

Table 1: Clinical characteristics of the patients.

Surgical technique

Digital anesthesia with epinephrine-free 1% lidocaine was performed after cleaning the site of operation with povidone-iodine solution. A tourniquet was applied to the proximal of the big toe. By using septum elevators, the ingrown nail was freed from the nail bad from the edge and distal to proximal, then the nail was cut longitudinally with 3-4 mm width from the ingrown portion, and extracted.

Eighty-five percent formic acid was applied with a cotton tipped applicator to the matrix of extracted part and rubbed into the nail bed. Formic acid application was performed two times 1 minutes each, for a total of 2 minutes. The site of operation was flushed with isotonic saline solution in order to neutralize the effect of formic acid. The tourniquet was removed, an antibiotic containing ointment was applied, and a gauze bandage was wrapped around the nail.

Postoperative care

All patients were followed-up for 1 week post operation with 2-day intervals and 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 3 months. During 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, NCSS (Number Cruncher Statistical System) 2007&PASS 2008 Statistical Software (Utah,

USA) was used for statistical analyses. When evaluating the 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 chi-square test were used for comparisons of qualitative data. Statistical significance was defined as $p<0.05$.

Results

The mean age of the patients was 36.96± 6.43. Of the 30 patients, 11 (44%) were male and 14 (56%) female. The mean follow-up duration of patients was 16.23 ± 5.33 months (6-24 months). Of the 44 ingrown toenails, 15 (34.1%) were defined as stage 2,9 (20.4%) as stage 1 and 20(45.5%) as stage 3. No recurrence was observed 25 patients during mean follow-up period. Adverse effects such as postoperative pain and drainage were minimal in most of the patients.

While 8 of the patients (32%) had mild pain, 4 (16%) moderate pain,2 (8 %) severe pain; 11 patients (44%) experienced no pain. Postoperative drainage improved within 10 days in 29 of the patients (96.6%) and within 15 days in 1 of the patients (3.3%). Postoperative infection was occured 3 patients (12%). Postoperative drainage improved within 15 days in 21 patients (84%), within one month in 2 patient (8%). Postoperative drainage improved more than one month in 2 patients(8%). This was considered to be statistically significant ($p<0.001$). None of the patients complained about cosmetic results.

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. The recurrence rates in wedge resections range from 3% to 33%. Excision of the proximolateral matrix segment has a 4% recurrence rate. The latter two procedures are difficult surgical techniques with postoperative complications including prolonged healing time, considerable pain, and frequent infections [3,10-14,5]. The Zadik's procedure has recurrence rates ranging from 14% to 28%, and postoperative pain and time off from work or school, along with poor cosmetic results, are the disadvantages [10,15,16]. Selective matricectomy must minimize damage to the surrounding normal skin and soft tissue in order to shorten the healing time and obtain a satisfactory cosmetic result.

There are two major methods in selective matricectomy: (a)mechanical and (b)chemical methods. Surgical matricectomy 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 (CO_2) laser for performing selective matricectomy [6,17-19].

The CO2 laser achieves more selective destruction of the nail matrix than chemical matricectomy, 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, healing fast with minimal postoperative morbidity, and high success rate. Chemical matricectomy is one of the ideal methods that meet all these criteria and produce perfect results. Chemical matricectomy following partial nail avulsion is known to be a successful and safe surgical therapeutic option for the treatment of ingrowing nails[3,7]. The objective of treatment is to chemically destroy the lateral matrix horn in order to prevent the lateral nail plate grow into the lateral nail fold in the future. Generally phenol and sodium hydroxide are used in chemical matricectomy [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 for its use [2]. Phenol matricectomy 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 pains, 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 a strong alkali can cause excessive damage due to slowly progressing liquefaction necrosis [22]. TCA is one of the most commonly used agents for chemical peel. It is used for superficial or medium depth chemical peeling. TCA is a caustic chemical

agent that causes coagulation necrosis, like phenol. It produces epidermal and dermal necrosis and then neutralizes by itself without serious systemic toxicity. In a recent study, Kim Su-Han et al. performed chemical matricectomy with 100% trichloroacetic acid in 25 patients with ingrowing toenail edges, and reported that the success rate was 95%[8].They reported that side effects such as postoperative pain, drainage and infection were mild, that postoperative drainage generally decreased within 1 week and did not last more than 2 weeks. Recently, we observed the effectiveness of matrix cauterization with TCA in the treatment of ingrown toenails [8,23,24].

Formic acid (85 %) is used in the treatment of viral warts [9-10]. Formic acid causes coagulative necrosis of cells through extensive protein denaturation and resultant structural cell death. This is the first study to use formic acid for the treatment of ingrown toenail. In our study, side effects such as postoperative pain and drainage were at a minimal level in the majority of the patients. None of the patients had postoperative infection. Bostancı et al., during 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 100%. In our study, 85% Formic acid matricectomy shows treatment success comparable to those of phenol, TCA and sodium hydroxide matricectomy.

In our trial, adverse effects such as postoperative pain and drainage were minimal in most of the patients. While 8 of the patients (32%) had mild pain, 4 (16%) moderate pain,2 (8 %) severe pain; 11 patients (44%) experienced no pain. Postoperative drainage improved within 10 days in 29 of the patients (96.6%) and within 15 days in 1 of the patients (3.3%). Serious postoperative infection was occured 3 patients (12%).Postoperative drainage improved within 15 days in 21 patients (84%), within one month in 2 patient (8%). Postoperative drainage improved more than one month in 2 patient(8%). Formic acid matricectomy is very successful in the treatment of ingrown toenails.But serious infections and delayed wound healing are the disadvantage of formic acid matricectomy. For this reason, sodium hydroxide or TCA matricectomy should be preferred instead of formic acid matricectomy.

Conclusion

Due to formic acid matricectomy has severe postoperative infection and delaying postoperative healing time, other matricectomy modalities should be preferred.

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