Onychoplasty with Carbon Dioxide Laser Matrixectomy for Treatment of Ingrown Toenails

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Ingrown toenails are one of the most common pathologic conditions encountered in podiatric medical practice. Many methods of treatment for ingrown toenails have been used and studied, including chemical matrixectomies, surgical approaches, and CO_2 laser ablation. This study is a retrospective review of a new technique that consists of resection of the involved nail matrix using a No. 15 blade and controlled cauterization using a CO_2 laser. The technique was performed on 381 painful ingrown toenails, and all of the patients were followed up postoperatively for an average of 34 months. The results showed minimal pain, a low recurrence rate, rapid return to activity, and good cosmesis. (J Am Podiatr Med Assoc 95(2): 175-179, 2005)

Ingrown toenails are one of the most common pathologic conditions encountered in podiatric medical practice. In one study,[1,2] nail disorders were found in 61% of podiatric medical patients, and onychocryptosis accounted for 26% of those disorders. Previously used treatments include chemical matrixectomies,[3-11] surgical procedures,[12-17] and, more recently, use of a CO_2 laser for ablation of the matrix.[18-24]

Chemical matrixectomies have been used with good results for many years.[1-9] Boll[3] first described chemical ablation using phenol in 1945, and Travers and Ammon[4] later described chemical ablation using sodium hydroxide. Both procedures have been well accepted for the treatment of onychocryptosis.[5] Various authors[1-9] have discussed these treatment modalities. The major variation is in application time, which ranges from 3 sec to 3 min for sodium hydroxide[4] and from 30 sec to 6 min for phenol.[1-9]

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Surgical procedures have also been used to treat pathologic nail conditions. The Winograd,[12,13] Frost,[14,15] and Zadick[16] procedures have all been used with documented success. Research[17] has shown that the Winograd and Frost techniques are the most popular. With both techniques, the surgeon makes an incision proximal to the eponychium to expose the germinal matrix and then resects the matrix using curettage or excision.[12-16]

More recently, use of a CO_2 laser has become popular.[18-24] Kaplan and Labandter[18] first reported a case in 1976 in which they used a CO_2 laser for ablation of the nail matrix in a patient with onychogryphosis. Multiple articles[19-21] described success with the use of only laser ablation of the matrix for onychocryptosis and onychomycosis. The benefits of laser ablation were precision of operative technique; decreased edema, infection, and hemorrhage; reduced pain; and more rapid return to activity. Combination onychoplasty and laser ablation has been used more recently. An incision is made proximal to the eponychium, allowing better surgical exposure, and then a CO_2

laser is used to ablate the matrix. Yang and Li[22] state that there is good cosmesis and decreased pain.

We developed a method for treating ingrown toenails that differs from those previously reported and is advantageous for both the surgeon and the patient in therapeutic, cosmetic, and technical aspects. This new procedure has improved the treatment methods available for the surgical correction of ingrown toenails.

Patients and Methods

A total of 154 patients who visited our podiatric medical office at The Foot and Ankle Institute, Ltd, Oaklawn, Illinois, with a chief complaint of painful ingrown toenails were reviewed in this study; 381 procedures were performed between January 1, 1999, and June 30, 2002, and the patients were followed up for a minimum of 1 year, with an average follow-up time of 34 months. Any infections were resolved before the procedure was performed, and all of the patients had adequate vascular status for healing.

The procedure is performed with the patient in a supine position. Local anesthetic is administered to block the digit, and the foot is prepared and draped using the usual aseptic technique. A tourniquet is then applied to the digit using a ¼-inch Penrose drain and a hemostat. An English anvil is used to split the offending nail border to the level of the eponychium (Fig. 1), and a No. 61 blade is used to incise the nail proximal to the eponychium to the level of the nail matrix (Fig. 2). The offending nail border is removed using a hemostat (Fig. 3). Surgical resection of the involved germinal matrix is performed using a No. 15 blade (Fig. 4). This incision is made

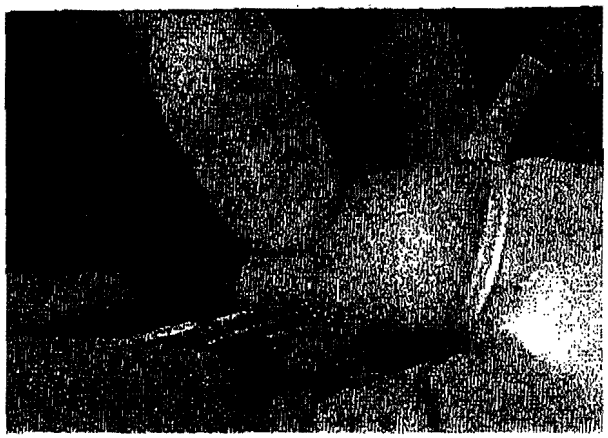

Figure 2. A No. 61 blade is used to incise the nail proximal to the eponychium to the level of the nail matrix.

parallel to the cut nail plate in an area 2 mm distal to the eponychium. The No. 15 blade is then used to pass inferior to the eponychium, thereby circumscribing the matrix. The blade is then turned 90° to incise the nail bed 2 mm distal to the eponychium. A rongeur is then used to excise the nail bed and adjacent matrix (Fig. 5). A CO_2 laser set at 10 W superpulse mode is then used to obliterate any remaining matrix from the phalangeal tuft (Figs. 6–8). The area is copiously irrigated with 0.25 mL of dexamethasone phosphate. The digital tourniquet is removed, and the toe is dressed with ADAPTIC Non-Adhering Dressing (Johnson & Johnson Wound Management Worldwide, Somerville, New Jersey) and a dry, sterile dressing. The patient wears a postoperative shoe or sandal on discharge. The patient is instructed to

Figure 1. A ¼-inch Penrose drain tourniquet was applied to the digit. An English anvil is used to split the nail border to the level of the eponychium.

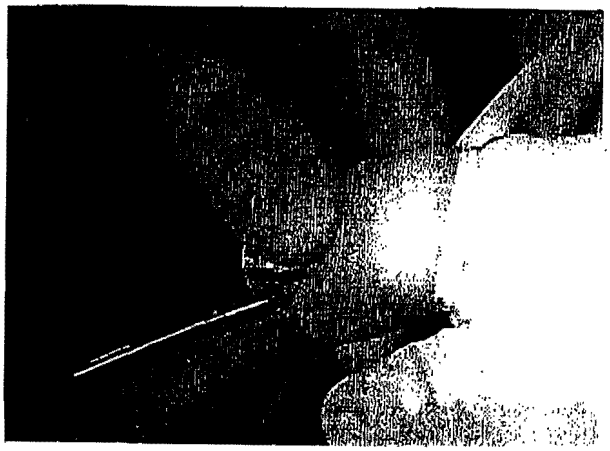

Figure 3. The offending nail border is removed with a hemostat.

Figure 4. Surgical resection of the involved germinal matrix is performed with a No. 15 blade. The incision is made parallel to the cut nail plate to an area 2 mm distal to the eponychium. The No. 15 blade then circumscribes the matrix inferior to the eponychium. The blade is then turned 90° to complete the incision of the nail bed, which is now 2 mm distal to the eponychium.

leave the dressing on for 8 hours and then change the dressing, keeping it dry and intact until the following day. On postoperative day 1, the patient can get the foot wet twice a day by taking a shower, soaking in warm water, or swimming.

Results

Four areas of interest were studied. First, recurrence, which was defined as any nail regrowth, was present in 2.1% of patients. Second, return to activity was considered either immediate or delayed. Only 1%

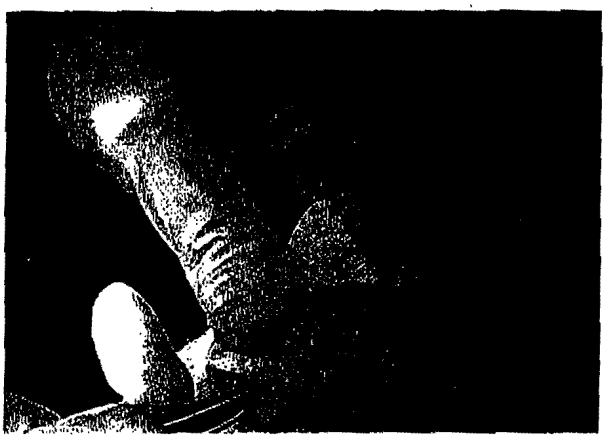

Figure 5. A rongeur is used to excise the nail bed and adjacent matrix.

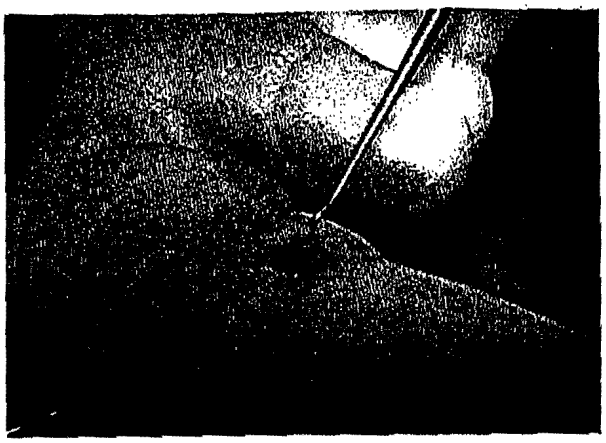

Figure 6. Remaining matrix adhered onto the phalangeal tuft.

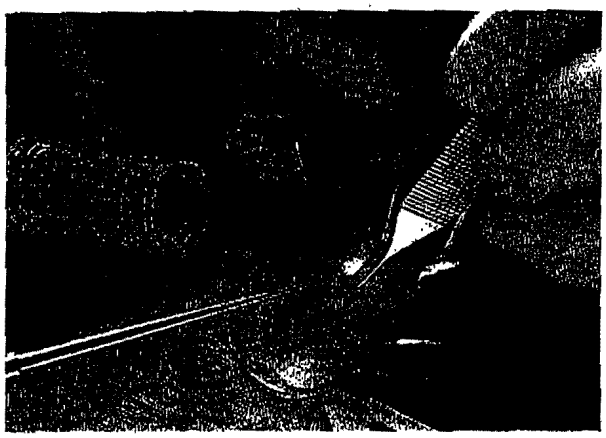

Figure 7. A CO_2 laser is used at 10 W superpulse to obliterate any remaining matrix from the phalangeal tuft.

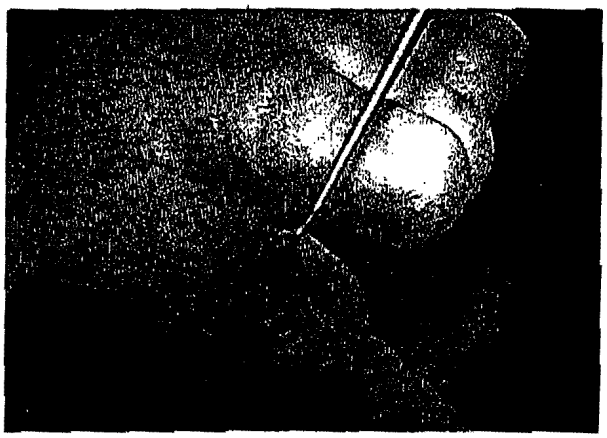

Figure 8. Result after the remaining matrix has been obliterated by the laser.

of patients were noted to have a delay in return to activity. Third, postoperative pain level was evaluated as being 1) mild, defined as the patient needing no pain control and having no postoperative complaints; 2) moderate, defined as the patient using analgesics for control of pain or complaint of pain; and 3) severe, defined as the patient calling the physician or making an appointment specifically because of pain. In 95.5% of cases no pain or mild pain was reported, in 4.5% of cases moderate pain was reported, and there were no reports of severe pain. Finally, any complications were noted and reviewed. Infection or abscess, defined as any excessive drainage, swelling, or inflammatory response, was seen most commonly (6.6%). Of 381 procedures, 6 (1.6%) resulted in granulomas, 3 (0.8%) in inclusion cysts, and 1 (0.3%) in a superficial hematoma.

Discussion

Many techniques have been used to correct onychocryptosis[1-24]; all have had some success, but there is definitely still room for improvement. Our procedure may be an improvement over previous methods used because the results have shown a low recurrence rate, minimal pain levels, rapid return to activity, and good cosmesis. These results are obtained without using harsh chemicals and by having precise control of the surgical process. In addition, adjacent structures suffer minimal harm.

The rate of infection was higher than expected at 6.6%. All of the patients were treated with antibiotics, and cultures were not always performed to prove the existence of infection. As this was a retrospective study, it could be that the patients who presented with infection had well-documented charting. On the other hand, patients without infection may not have returned for follow-up, and, therefore, the chart may not have been used in the study, which would essentially increase the percentage of infections.

The results of the present study show distinct advantages over previous techniques used. Chemical ablation has been a popular method of resolving ingrown toenails. However, it has been shown to have varying results,[8-11] with recurrence rates ranging from 1.1%[8] to 24%.[10] The procedure of chemical ablation is relatively painless owing to the chemicals used. The chemical cauterizes the nerve endings and essentially anesthetizes the operative field.[6, 8, 11] Nonetheless, there are drawbacks to using chemicals, and some technical factors can cause serious complications. The major factor is the unpredictability of chemical dispersion, which causes necrosis of adjacent tissues[2] and possibly loss of the digit.[25, 26] Finally, another disadvantage of using chemical ablation with phenol is its possible carcinogenic properties. Evidence of topical application of phenol from the rat model has demonstrated hepatocyte cytotoxicity.[27] Other studies[28-30] have also shown phenol to be a tumor promoter in mice. Because there is insufficient animal and human data concerning its carcinogenic properties, phenol has been classified as group D, defined as not classifiable as to its human carcinogenicity.[31] The new technique described is without hazy data and is both safe and effective, making it a more precise procedure with a lower recurrence rate.

Onychoplasty is another technique frequently used to treat onychocryptosis.[13-17] The major drawbacks of this method are the pain level and the time it takes to heal, which delays the patient's return to activity. With onychoplasty, an incision is made that courses proximal to the eponychium.[12-16] This area is highly innervated,[32] and an incision in this area causes the increased pain. Consequently, this area needs to be avoided. There is a delay in activity with onychoplasty as well. Either sutures or Steri-Strips (3M Health Care, St Paul, Minnesota) are needed to approximate the incision and allow healing to occur.[2-16] Our procedure requires no sutures, allowing a normal return to activity, including the ability for the area to get wet, and decreased pain by avoiding the highly innervated areas.

The CO_2 laser used in newer studies also adjunctively makes an incision proximal to the nail fold,[21-23] resulting in increased pain and longer healing times. In some studies, sutures remained in place for up to 4 weeks.[21] Also, the lasers used in previous studies were continuous CO_2 lasers, which caused extensive tissue destruction *via* thermal necrosis.[26] The present study used a pulse-mode laser, which consists of controlled short-duration, high-powered pulses. The benefit of this type of laser is the ability to destroy selected tissue with minimal adjacent tissue necrosis. Pulse-mode lasers have been shown to minimize the amount of protein coagulation and to result in a fraction of the necrosis associated with continuous-wave lasers.[26]

Conclusion

This new procedure has improved surgical treatment for ingrown toenails. It is more comfortable for the patient, enables a more rapid return to activity, and has decreased recurrence rates compared with previous procedures. This procedure gives the surgeon control over the area of nail being ablated, unlike chemical treatments. It also involves less pain than previous open procedures. The podiatric medicine

profession prides itself on rapid pain relief and reliable treatment that enables patients to quickly return to their activities of daily living. This procedure exemplifies both of these characteristics.

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