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A COMPREHENSIVE REVIEW OF SURGICAL TREATMENTS FOR INGROWING TOENAILS

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ABSTRACT

Ingrown toenails, also known as onychocryptosis, are a very common condition that affects patients' quality of life due to pain, inflammation, and the risk of infection. While conservative treatment is effective in mild cases, more severe or chronic forms of the condition usually require surgical intervention. Over the years, numerous surgical methods have been developed to improve treatment outcomes, reduce the risk of recurrence, and minimize postoperative complications. This review presents an evaluation of various surgical strategies, analyzing their effectiveness, advantages, disadvantages, and patient outcomes based on current clinical evidence.

Ingrown Toenail Before Surgical Treatment: [Clinical Presentation from Private Collection]

KEYWORDS

Ingrown Toenail, Onychocryptosis, Chemical Matrixectomy, Nail Surgery, Laser Therapy

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1.1 Introduction

Ingrown toenails, medically referred to as onychocryptosis or *unguis incarnatus*, are among the most common foot disorders, causing discomfort, reduced functionality, and diminished quality of life for many patients [1,6,21]. The condition arises when the lateral edge or corner of the nail penetrates or exerts continuous pressure on the surrounding skin, most commonly affecting the big toe. This pressure leads to localized inflammation, pain, redness, and, in many cases, secondary bacterial infection. If left untreated or inadequately managed, symptoms may worsen, leading to impaired mobility and daily functioning, and may ultimately require surgical intervention.

The prevalence of ingrown toenails varies across populations but is particularly high among adolescents and young adults, ranging from 2.5% to 5% [6,20]. Multiple factors influence the development and progression of the condition, including improper nail-cutting techniques, wearing overly tight or poorly fitting shoes, toe trauma, genetic predisposition, anatomical abnormalities of the nail or toes, and harmful lifestyle habits [6,15,20]. Adolescents and young adults are especially vulnerable due to increased physical activity, poor footwear choices, and frequent improper nail care practices, highlighting the need for preventive education within this age group [15,20].

Initial treatment of ingrown toenails typically involves conservative, non-surgical methods aimed at reducing inflammation, alleviating pain, and preventing complications. These methods include regular warm saline foot soaks, education on proper nail trimming, changes in footwear, and, when necessary, the use of topical antiseptics or antibiotics to manage mild infections [8,9,15]. While these approaches are effective in

relieving mild symptoms or early stages of the condition, their effectiveness significantly diminishes in recurrent, chronic, or severe cases [1,2,4,14].

When conservative treatment proves ineffective and symptoms tend to recur, surgical management becomes necessary. Over the past few decades, many surgical techniques have been developed and refined—ranging from simple removal of the offending nail edge to more invasive procedures involving permanent destruction or excision of the nail matrix responsible for regrowth [2,3,10,12,14,18]. Choosing the most appropriate surgical method requires consideration of multiple patient-specific factors, such as the severity and chronicity of the condition, previous treatment outcomes, recurrence risk, cosmetic concerns, recovery time, economic limitations, and the patient's personal preferences [1,4,5,11,13].

Despite considerable progress in the surgical management of ingrown toenails, controversies remain regarding the most effective treatment methods, strategies for recurrence prevention, and postoperative care protocols [7,14]. Therefore, it is essential to regularly evaluate surgical outcomes, compare new and traditional techniques, and tailor therapy to individual patient needs. This review assesses the current state of surgical interventions for ingrown toenails, aiming to present the available options for selecting the most appropriate therapeutic approach based on scientific evidence and a patient-centered perspective.

1.2. Methodology

This article is based on a narrative literature review. To collect the most relevant information, we searched medical databases such as PubMed, Scopus, and Google Scholar between January and March 2025. We used keywords including ingrown toenail, onychocryptosis, nail surgery, matrixectomy, phenolization, and laser treatment.

We focused mainly on publications from the years 2000–2025 that described surgical approaches to ingrown toenails. Both randomized clinical trials and observational studies were taken into account. Articles were included if they reported on treatment outcomes, recurrence rates, patient satisfaction, or possible complications. Very small case reports and studies without clinical outcome data were not considered. The process of selecting studies was carried out by the authors through independent review of titles, abstracts, and then full texts. Any doubts were discussed together until consensus was reached. Information was then organized and compared with the aim of presenting the most common surgical methods, their advantages, disadvantages, and effectiveness. Because the studies we found used different designs and outcome measures, we did not combine results into a statistical meta-analysis. Instead, we present a descriptive summary that highlights the main trends, areas of agreement, and gaps in current knowledge.

2. Surgical Treatment Options

2.1. Partial Nail Avulsion with Chemical Matrixectomy

Partial nail avulsion combined with chemical matrixectomy is one of the most commonly performed surgical procedures for the treatment of ingrown toenails. This technique involves the surgical removal of the lateral portion of the nail plate and the application of chemical agents, such as phenol or trichloroacetic acid (TCA), to the nail bed to inhibit regrowth. Phenolization is a particularly popular method due to its simple application, low cost, and low recurrence rate. Comparative clinical studies demonstrate better long-term outcomes with phenol compared to TCA; however, its use is associated with a longer recovery period and a higher risk of infection. Alternatively, electrocautery has emerged as a technique with comparable effectiveness, characterized by fewer postoperative complications, making it increasingly popular in clinical practice [4,5,12,17].

2.2. Winograd Procedure

The Winograd method involves the surgical removal of the diseased part of the nail along with partial excision of the nail matrix to reduce the risk of recurrence [10]. Modifications introduced in recent years have made this procedure minimally invasive, which promotes faster healing and reduces postoperative discomfort. A study evaluating these minimally invasive modifications demonstrated a high level of patient satisfaction and very good treatment outcomes [10]. As a result, the modified Winograd procedure is gaining increasing popularity, particularly in cases of recurrent ingrown toenails.

2.3. Surgical Matrixectomy

In more severe cases and those with a high risk of recurrence, surgical matrixectomy—consisting of complete or partial removal of the nail matrix—is recommended [11,12,19]. Matrixectomy techniques include traditional surgical excision, electrosurgical removal, or laser ablation of the nail matrix [12,18]. Although surgical matrixectomy provides a permanent solution, it results in a lasting alteration of the nail's appearance. Chemical matrixectomy using phenol is generally associated with lower recurrence rates, whereas traditional surgical methods tend to offer better cosmetic outcomes [5,16]. Studies have shown that matrixectomy techniques with suturing may enhance wound healing and increase patient satisfaction with the final outcome compared to non-sutured methods [11].

2.4. Sutured Surgical Techniques

Some surgical techniques involve excision of the ingrown portion of the nail followed by careful suturing to ensure optimal healing and improve cosmetic outcomes [11]. These methods require surgical precision and often better aesthetic results. Despite their effectiveness, they are associated with a slightly higher risk of recurrence compared to chemical matrixectomy [11]. Patient satisfaction remains notably high, especially among those for whom cosmetic results are more important.

2.5. Electrosurgical and Laser-Assisted Treatments

Modern methods, including electrosurgical and laser matrixectomies, allow precise destruction of the diseased nail matrix with minimal damage to surrounding tissues [18]. Laser matrixectomy is gaining increasing popularity due to faster healing times and reduced postoperative pain. Comparative analyses shows the superiority of laser therapy over traditional phenol-based methods, mainly in terms of recovery time and patient comfort. However, higher costs and the need for specialized equipment limit its wider availability and distribution [18].

2.6. Minimally Invasive and Novel Approaches

Alternatives such as home-based self-treatment kits and specialized taping methods have recently appeared as non-surgical options for mild to moderate cases. These therapies effectively reduce presenting symptoms and have been shown to delay or prevent the need for surgical interventions [8,9]. Although these approaches provide immediate relief and convenience, clinical evaluations suggest that they are generally less effective in preventing long-term recurrence compared to surgical treatment, focusing on their complementary rather than replacement role in managing ingrown toenails.

3. Comparison of Surgical Techniques

When comparing various surgical techniques used in the treatment of ingrown toenails, several studies draw attention to major differences including effectiveness, recurrence rates, cosmetic outcomes, patient comfort, and complications. Choosing the most appropriate surgical method requires careful consideration of these factors along with the patient's individual preferences and clinical condition. Chemical matrixectomy, particularly phenol-based methods, consistently stands out as one of the most effective techniques, demonstrating exceptionally low recurrence rates in many clinical studies [5,17]. A systematic review and meta-analysis of randomized controlled trials highlighted the superior effectiveness of phenolization in preventing recurrence compared to alternative methods [5,13]. Despite these advantages, phenol matrixectomy is associated with certain disadvantages, such as longer healing time and a mild increase in risk of postoperative complications, especially infections [12,17]. Consequently, some researchers recommend other matrixectomy options, such as electrocautery, which offers similar effectiveness but may shorten recovery time and reduce complications [12].

On the other hand, surgical matrixectomy performed with the traditional scalpel technique has an advantage from the perspective of aesthetic results. Studies on surgical matrixectomy techniques shows better cosmetic outcomes, especially when combined with suturing [11]. Sutured methods support better healing and result in a high level of patient satisfaction with the final results, particularly among those concerned with aesthetics [11]. However, the cosmetic benefits must be considered against a slightly higher recurrence rate compared to chemical matrixectomy. A recent relative analysis showed that sutured surgical methods, even with their high effectiveness and good aesthetic results, are connected with a slightly increased risk of recurrence [11].

Laser and electrosurgical procedures represent more advanced options that have gained popularity. These minimally invasive techniques specifically focus on the nail matrix while protecting surrounding tissues, reducing postoperative pain and shortening healing time [18]. According to recent comparative studies, laser-assisted matrixectomy achieves similar or even superior effectiveness compared to phenolization, while significantly decreasing patient discomfort and promoting rapid recovery [18,21]. However, due to high costs and the need for specialized equipment, its wider use is limited, especially in resource-limited settings. [18,21].

The Winograd procedure, particularly its modern minimally invasive modifications, that shows promising results in recurrent cases [10]. Clinical studies reviewing the updated Winograd technique report quick healing, low postoperative discomfort, and high levels of patient satisfaction. [10]. This makes the Winograd procedure very appealing as a compromise between invasiveness, recurrence prevention, and cosmetic outcomes, suitable for patients valuing both functionality and aesthetics [10].

Innovative minimally invasive techniques, including home treatment kits and specialized taping methods, have appeared as additional strategies, primarily used at mild to moderate cases [8,9]. Clinical examinations of these methods show that they offer fast symptom relief and potentially delaying or even avoiding the need for surgical intervention [8,9]. However, their effectiveness in preventing recurrence is lower than traditional surgical methods, especially in advanced or recurrent cases [8].

Segmental nail matrix excision is another surgical option that has demonstrated promising outcomes in terms of recurrence prevention, healing speed, and cosmetic satisfaction [19]. This technique includes partial removal of the affected nail matrix segment without complete nail removal, consequently preserving to a great extent the nail's visual appeal. Clinical data show that this method offers a good balance between effectiveness, reduced recurrence risk, and increased patient satisfaction, particularly for those preferring less aggressive procedures [19].

In summary, phenol-based chemical matrixectomy continues to be a highly recommended method for patients with recurrent ingrown toenails due to its high effectiveness and low recurrence rate. Sutured surgical matrixectomy and the Winograd procedure are favorable choices for patients prioritizing cosmetic outcomes and rapid recovery. Laser and electrosurgical techniques offer greater comfort and faster healing, although their high cost remains a significant barrier. Minimally invasive methods, such as home treatments or taping, play a supportive role and are best suited for early-stage disease or as temporary options before definitive surgical intervention. The best treatment outcomes and patient satisfaction are achieved through an individualized strategy that considers patient preferences, condition severity, risk of recurrence, and cosmetic expectations. [1,4,5,10,11,12,13,17,18,19,21].

4. Postoperative Care and Prevention

Successful postoperative care plays a key role in preventing recurrences and achieving the best possible treatment results. This includes proper wound treatment, pain control, educating patients about good foot hygiene, and choosing suitable footwear, all of which influence long-term therapy success [14]. Techniques involving segmental excision of the nail matrix stand out for achieving good results in cosmetic results, reducing recurrence rates, and achieving high satisfaction [19].

5. Results and Future Directions

Surgical treatment of ingrown toenails continues to improve, offering many effective methods suitable to the different needs of patients. Chemical matrixectomy, especially phenolization, is widely used due to its simplicity, demonstrated good results and being affordable. Newer surgical techniques, including laser and electrosurgical methods, give significant benefits in terms of precision, patient comfort, and rapid recovery, although their higher costs and limited availability still makes it difficult to common use. Traditional techniques, such as the Winograd procedure and sutured matrixectomy, are known for their cosmetic outcomes and patient satisfaction. Future research should focus on improving less invasive surgical methods and creating new non-surgical treatments. Detailed comparative studies and long-term follow-ups are needed to determine the best techniques based on each patient's condition and needs It is also important to find affordable options, increase patient access to advanced treatments, and improve care after surgery to boost patient satisfaction, reduce the chance of recurrence and pain, also achieve better overall results. Combining conservative treatments with the right surgical options may offer the most complete and patient-friendly way to manage this common but challenging problem.

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Conceptualization and methodology – Magdalena Kowalczyk
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