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RESEARCH

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# Modified Winograd technique versus partial resection with electrocoagulation for surgical management of ingrown toenails

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## Abstract

**Background** Ingrown toenails significantly impact quality of life. This study compares the clinical outcomes of the modified Winograd method versus partial resection with matrix electrocoagulation. We hypothesize that electrocoagulation will result in lower recurrence rates, shorter recovery times, and higher patient satisfaction compared to the modified Winograd method.

**Methods** We analyzed data from 132 patients who underwent surgery at our hospital between January 2016 and January 2023. The patients were divided into two groups: Group A (69 patients), who underwent the modified Winograd procedure, and Group B (63 patients), who received partial nail excision with matrix electrocoagulation. We compared recurrence rates, recovery times, patient satisfaction, types and frequencies of complications, and VAS pain scores. Statistical analysis was performed using the t-test and chi-square test.

**Results** Recurrence rates were 15% in Group A and 10% in Group B ($p=0.251$). Infection rates were 10% in Group A and 8% in Group B ($p=0.459$). The average recovery time was 11 days for Group A (range: 5–21 days) and 9 days for Group B (range: 5–20 days) ($t=2.81$, $p=0.006$). Postoperative VAS scores decreased significantly, with Group B showing a greater reduction in pain ($t=3.18$, $p=0.002$). Patient satisfaction was higher in Group B, though the difference was not statistically significant (Chi-square = 6.45, $p=0.091$).

**Conclusion** The modified Winograd method remains effective, with high satisfaction and low recurrence rates. However, partial nail resection with matrix electrocoagulation offers shorter recovery times and greater pain reduction.

**Level of evidence III** Retrospective comparative study.

**Keywords** Clinical outcomes, Electrocoagulation, İngrown toenail, Modified Winograd method, Partial nail resection

## Introduction

One of the major health issues affecting the population today is ingrown toenails, which hinder individuals from enjoying the best quality of life. This condition leads to infection, inflammation, pain, and discomfort when the nail penetrates the soft tissue. In the literature, conservative methods such as soaking in warm water, grooving, appropriate nail trimming and spicule removal, as well as nail bracing, have been applied to mild and moderate (stage 1–2) ingrown nails, with varying success rates reported. However, in cases where conservative treatment fails or in more advanced cases (stages 2–3), a surgical approach is recommended, which involves the removal of the affected portion of the nail along with its matrix. Without surgical intervention, recurrence is quite likely. In addition to the use of phenol and similar

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chemicals, as well as guttering treatment, various surgical procedures and their combinations have been described, which involve partial or total removal of the nail plate. A well-known surgical treatment is the modified Winograd procedure, which has proven to be effective. This technique is associated with high patient satisfaction rates and a low risk of complications. Additionally, outpatient care enhances patient satisfaction by ensuring minimal discomfort during recovery. However, although the technique is commonly used, several studies report disadvantages such as a relatively long recovery time, recurrence, poor cosmetic results, and postoperative pain [1–5].

Recently, a technique involving partial removal of the ingrown nail combined with electrocoagulation of the matrix has been developed and applied as an alternative to the modified Winograd method. This approach is minimally invasive and requires only the use of electrocoagulation, eliminating the need for additional skin incisions or the use of a scalpel and curette, as is the case with the modified technique. Furthermore, the wound is left to heal naturally without sutures. Recent studies have demonstrated that matrix electrocoagulation offers significant advantages, including reduced postoperative pain, faster return to activity, shorter recovery times, lower recurrence rates, and consequently, increased patient satisfaction [5–9].

The hypothesis of this study is that partial nail resection combined with matrix electrocoagulation effectively reduces postoperative pain, lowers recurrence rates, and leads to a faster return to activity, ultimately improving patient satisfaction when compared to the modified Winograd procedure. To date, there has been no comprehensive comparative analysis of the clinical outcomes between the modified Winograd technique and partial nail resection with matrix electrocoagulation. This study aims to fill this gap by evaluating and comparing the clinical outcomes of both techniques, focusing on recurrence rates, recovery time, patient satisfaction, and potential postoperative complications through a retrospective analysis.

## Methods

A retrospective review was conducted on 132 patients who underwent surgical treatment for ingrown toenails and visited our clinic between January 2016 and January 2023. Demographic data collected included age, sex, and socioeconomic status (SES). Patients from various socioeconomic backgrounds were included. The study included patients with Heifetz stage 2 and 3 ingrown toenails who had not responded to conservative treatments and who had at least 1 year of postoperative follow-up. All participants provided informed consent prior to surgery. Exclusion criteria included, but were not limited to, Heifetz stage I ingrown nails, previous surgical interventions for ingrown toenails, structural nail abnormalities, trauma-induced nail deformities, fungal infections (onychomycosis), vascular disease, and diabetes mellitus. Surgical intervention was performed in patients with purulent drainage and infection after the complete resolution of the infection, following one week of oral antibiotic treatment.

This study utilized a retrospective cohort design. Patients were divided into two groups: Group A consisted of those who underwent the modified Winograd method, while Group B included those who received partial resection of the ingrown toenail with matrix electrocoagulation. Demographic factors such as sex, age, and Heifetz stage were matched after data collection to ensure comparability between the groups. Post hoc matching, or adjustments made after the initial analysis, were performed to control for potential biases. Although randomization was not applied in this study, efforts were made to minimize bias through rigorous data analysis. Data were obtained from hospital records during patient visits and from follow-up telephone interviews.

Eligible patients who sought treatment at the clinic were selected for the study based on their availability and the completeness of their medical records. During preoperative preparation, all patients received a digital nerve block anesthesia, and the surgical area was disinfected with a 10% povidone-iodine solution. A tourniquet was applied to the toe to control external bleeding. Group A underwent the modified Winograd procedure. In this technique, a small skin incision (0.5–1 cm) was made proximally at the nail root level. The nail bed and germinal matrix were then excised and debrided using a No. 15 scalpel. After irrigating the wound with saline, both the skin at the nail root level and the nail edge were sutured to the surrounding skin using 2–0 prolene (Fig. 1). For Group B, ablation of the germinal matrix and nail bed at the level of the nail root was performed using a monopolar cautery set to 30 W, without making any incisions in the skin. Subcutaneous ablation was carried out in the nail root area to ensure precise treatment. The ablation process lasted between 5 and 6 s, and the nail edge was not sutured, allowing for secondary healing without stitches (Fig. 2). Both surgical procedures involved similar steps: hypertrophic tissue was debrided, the nail margins were elevated with mosquito forceps, and the nail was cut lengthwise to the root. The final step was to remove the tourniquet and dress the wound with soft, non-compressive sterile gauze.

The patients were admitted overnight for the first day of postoperative pain management and were discharged the following day after the initial dressing was applied.


**Fig. 1** Modified Winograd Technique for the Surgical Treatment of Ingrown Toenails. **a** Preoperative view of the ingrown toenail. **b** Elevation of the ingrown nail edge using a mosquito clamp. **c** Excision of the ingrown nail edge, nail bed, and germinal matrix, accompanied by a skin incision at the nail root level. **d** Suturing of the skin at the nail root level and nail edge

They were instructed to change their dressings daily and avoid wearing shoes for 5 days.

All patients received the same oral analgesic and prophylactic oral antibiotic therapy for five days postoperatively. Patients were seen in the clinic weekly until complete wound healing was achieved, and sutures were removed on the 14th day.

All patients were clinically followed up at 1, 2, and 6 months postoperatively to assess wound healing, infection, satisfaction, and recurrence. Additionally, satisfaction levels and recurrence status were evaluated at 12 months through phone calls or clinic visits.

This study employed specific measurement tools and techniques. Pain scores were recorded before and

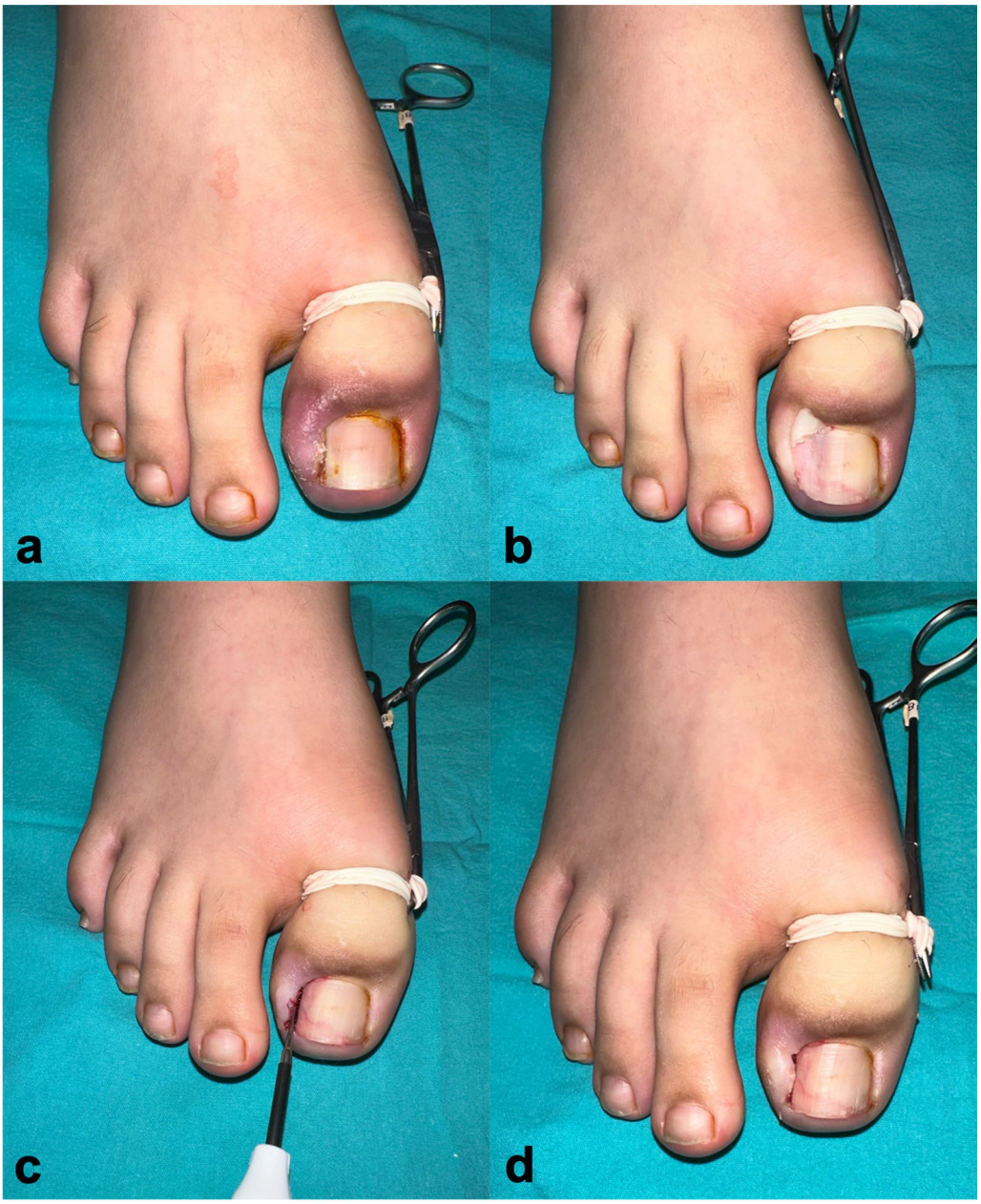


**Fig. 2** Partial Nail Excision with Matrix Electrocoagulation for the Surgical Treatment of Ingrown Toenails. **a** Preoperative view of the ingrown toenail. **b** Elevation of the ingrown nail edge using a mosquito clamp. **c** Excision of the ingrown nail edge without a skin incision, followed by electrocoagulation of the nail bed and germinal matrix. **d** Final postoperative view with no suturing

after surgery using a 10-point Visual Analogue Scale (VAS), where 0 represented the absence of pain and 10 represented the most severe pain imaginable. The time taken to return to work and resume daily activities, including wearing shoes, was recorded to assess recuperation (recovery time). Patient satisfaction was assessed using a 10-point VAS. Satisfaction levels were classified as follows: > 7 indicating 'very satisfied', 6 or 7 indicating 'satisfied', 4 or 5 indicating 'dissatisfied' and < 4 indicating 'very dissatisfied' [9].

The reasons for dissatisfaction included persistent pain after the operation, recurrence of the condition, infection, prolonged time to return to work and daily activities, and discomfort when wearing shoes.

All surgical procedures and follow-up examinations were conducted by the same surgeon. Data collection was carried out in a double-blind manner.

### Statistical analysis

Data were analyzed using SPSS software to perform statistical analyses. Group differences were evaluated using Student's t-tests for continuous data and chi-square tests for categorical data. Statistical significance was set at a p-value below 0.05. To account for multiple comparisons, the Bonferroni correction was applied.

## Results

The mean age of patients was 37.0 years (range, 20–68) in Group A and 35.0 years (range, 18–71) in Group B, with no significant difference between the two groups ($p=0.06$).

In terms of gender distribution, 60% of patients in Group A were female, and 40% were male, while 62% of patients in Group B were female, and 38% were male. No statistically significant difference was observed between the groups in terms of gender distribution ($p=0.06$).

Regarding medial and lateral involvement of the toe, 36% and 64% of patients in Group A, and 23% and 77% of patients in Group B, respectively, showed involvement ($p=0.05$).

According to the Heifetz classification for ingrown toenail, 36% of patients in Group A were classified as stage 2, and 64% as stage 3. In Group B, 46% of patients were stage 2, and 54% were stage 3. No statistically significant difference was found between the groups based on Heifetz staging ($p=0.06$) (Table 1).

The recurrence rate was 15% in Group A and 10% in Group B, with no statistically significant difference (Chi-square = 2.78, $p=0.251$). Similarly, infection rates were 10% in Group A and 8% in Group B, with no statistically significant difference observed (Chi-square = 1.56, $p=0.459$).

In Group A, 45.68% of patients reported satisfaction levels between 8 and 10, while 59.74% of patients in Group B reported similar satisfaction levels. Although no statistically significant difference was found between the groups in terms of patient satisfaction, patients in Group B reported higher satisfaction levels (Chi-square = 6.45, $p=0.091$) (Table 2) (Fig. 3).

In Group A, the return to activity ranged from 5 to 21 days, with a mean of 10.97 days. In Group B, the range was from 5 to 20 days, with a mean of 9.42 days. Although the ranges were similar, the mean time to return to activity was significantly shorter in Group B compared to Group A ($p<0.05$), indicating that patients in Group B returned to normal activities more quickly (Fig. 4).

The mean preoperative VAS score was 7.63 (range: 5–9) for Group A and 7.56 (range: 5–9) for Group B. No significant difference was found in the preoperative VAS scores between the two groups (t-statistic: 1.45, $p=0.151$). The mean postoperative VAS score was 1.68 (range: 0–7) for Group A and 0.97 (range: 0–5) for Group B. A significant decrease in postoperative VAS scores was observed in both groups. However, when comparing postoperative VAS scores between the two groups, a greater reduction in pain was observed in Group B, with this difference being statistically significant (t-statistic: 3.18, $p=0.002$) (Fig. 5).

## Discussion

Ingrown toenails affect millions of people worldwide each year, significantly impacting their quality of life. This condition can lead to severe pain, infection, and difficulty performing daily activities such as walking. Although several surgical treatment options are available, there remains a need for further confirmation of their efficacy.

**Table 1** Clinical Patient Characteristics

| Clinical characteristic | Modified Winograd method | Partial resection with matrix electrocoagulation | *P* value |
|---|---|---|---|
| *Age (yr)* | | | 0.06 |
| Mean | 37.0 | 35.0 | NA |
| Range | 20–68 | 18–71 | NA |
| *Sex* | | | 0.06 |
| Female | 60.0% | 62.0% | NA |
| Male | 40.0% | 38.0% | NA |
| *Side of toe involvement* | | | 0.05 |
| Medial | 36.0% | 23.0% | NA |
| Lateral | 64.0% | 77.0% | NA |
| *Heifetz stage* | | | 0.06 |
| Stage 2 | 36.0% | 46.0% | NA |
| Stage 3 | 64.0% | 54.0% | NA |

**Table 2** Follow-up Results and Chi-square Test Outcomes

| Outcome | Group A (%) | Group B (%) | Chi2 statistic | *p*-value |
|---|---|---|---|---|
| Recurrence | 15 | 10 | 2.78 | 0.251 |
| Infection | 10 | 8 | 1.56 | 0.459 |
| Satisfaction (1–3) | 4.94 | 1.30 | 0.82 | 0.365030 |
| Satisfaction (4–5) | 2.47 | 2.60 | 0.00 | 1.000000 |
| Satisfaction (6–7) | 41.98 | 31.17 | 1.97 | 0.160769 |
| Satisfaction (8–10) | 45.68 | 59.74 | 1.32 | 0.250935 |

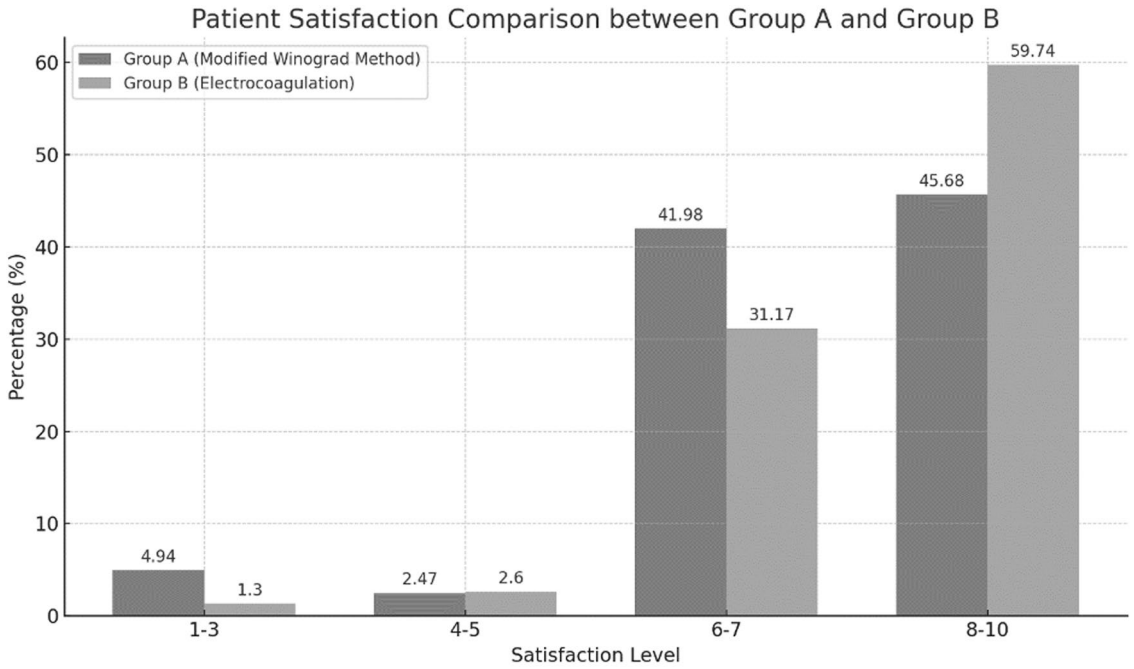


**Fig. 3** Patient Satisfaction Comparison between Group A and Group B

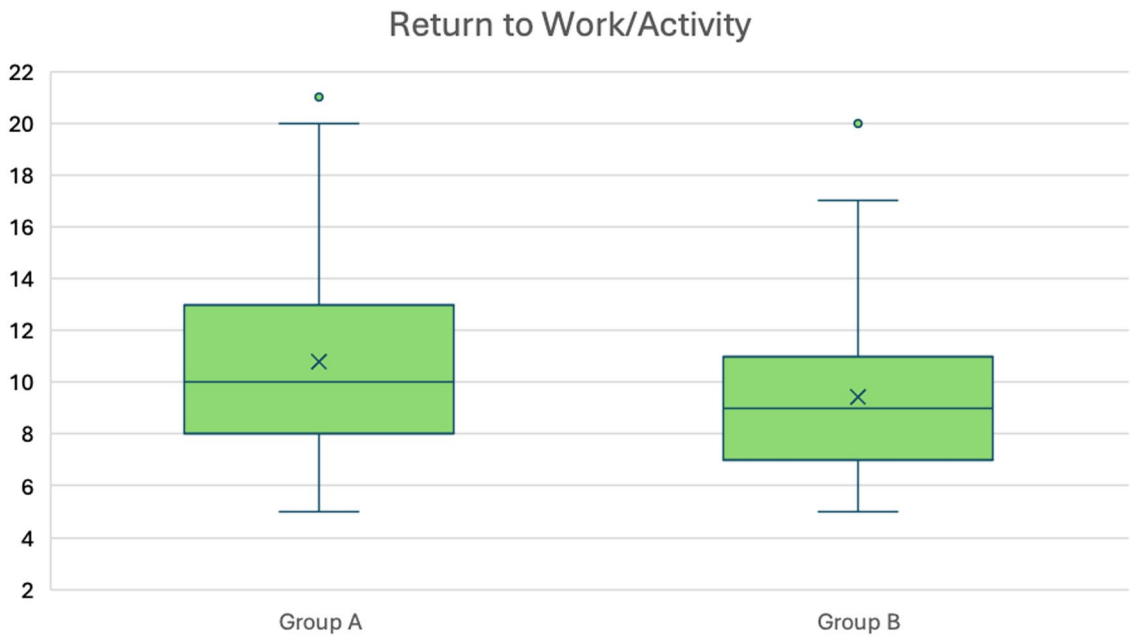


**Fig. 4** Return to Work/Activity Times for Group A (Modified Winograd Method) and Group B (Electrocoagulation)

Understanding the differences between these techniques is crucial for determining the most appropriate treatment for individuals suffering from ingrown toenails [9, 10].

Our study reveals both similarities and differences in recurrence and infection rates when compared to other studies in the literature. In a study by Karacan and Ertilav [4], the recurrence rate in the group treated with the

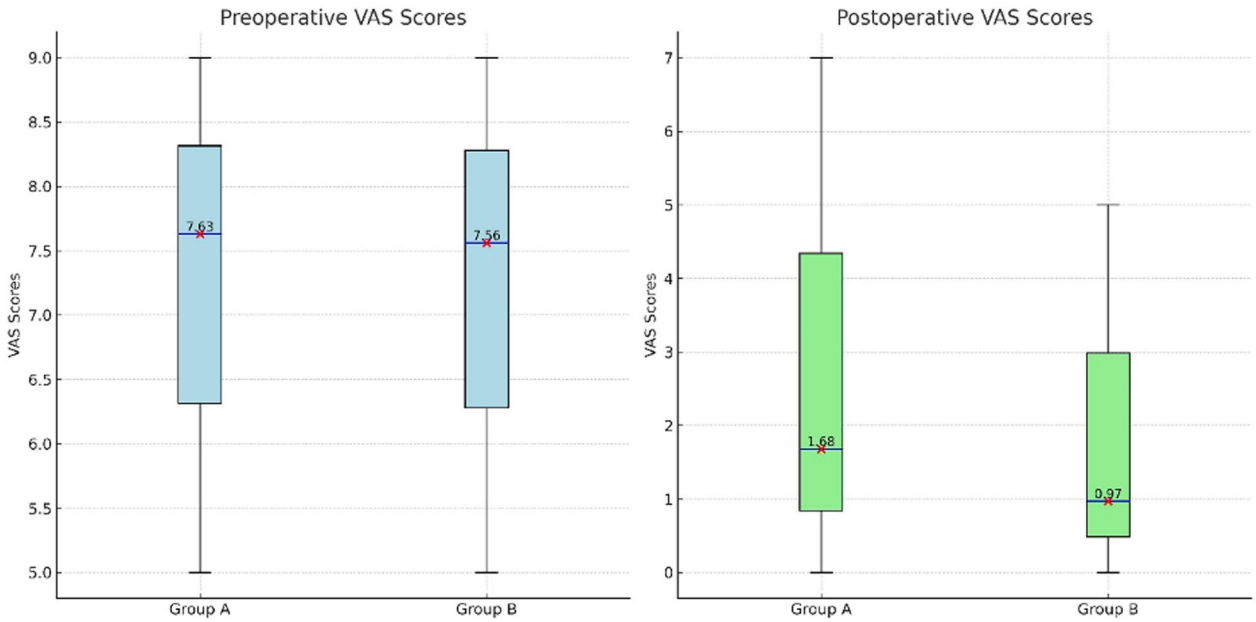


**Fig. 5** Preoperative and Postoperative VAS Scores for Group A (Modified Winograd Method) and Group B (Electrocoagulation)

Winograd method was reported as 14%, which aligns with our findings. However, a study by Kim et al. [10] reported a much lower recurrence rate of 3.95% in the group treated with the Winograd method. Recent studies have suggested that matrixectomy with electrocautery may further reduce recurrence rates [6, 11]. Amarin et al. [11] showed that adding electrocoagulation to matrix excision and curettage reduced recurrence rates from 25.4% to 4.2% and infection rates, while Sargin et al. [6] found no significant effect on infections, a result consistent with our findings. Additionally, in a study by Dharmawan et al. [12], wedge resection and matricectomy with electrocautery were used to treat recurrent ingrown toenails, resulting in successful outcomes with no recurrence or infection in any patients during a one-year follow-up.

In Group B, the use of the electrocoagulation method resulted in a shorter return to activity time and higher patient satisfaction compared to the modified Winograd technique. Upon reviewing the literature, Ergun et al. [13] found that patients who underwent surgery with the Winograd technique had a longer return to activity time and higher postoperative VAS scores compared to those treated with alternative methods. Conversely, Karacan and Ertilav [4] reported that patients treated with the Winograd technique had faster recovery and a shorter return to work compared to those treated with alternative techniques. Similarly, Kaya and Coskun [14] suggested that the Winograd method may promote rapid recovery; however, their study did not include a comparison with electrocoagulation. In a pilot study conducted by Singal et al., all patients underwent partial nail avulsion with radiofrequency (RF) ablation of the matrix, resulting in rapid healing within one week, significant reductions in ooze, pain, and swelling, and no adverse effects such as postoperative pain, drainage, recurrence, or secondary infections, highlighting RF ablation as a safe and effective method that significantly shortens recovery time [15]. A study on whether or not to suture the nail edge after the Winograd technique found that suturing was associated with faster healing, lower recurrence rates, higher patient satisfaction, and an earlier return to daily activities [7]. In contrast, our study found that although no sutures were applied in the electrocoagulation group, patients had higher satisfaction and returned to daily activities more quickly compared to the sutured Winograd method. These results suggest that electrocoagulation is more effective in reducing recovery time and enhancing patient satisfaction.

Both the modified Winograd technique and the electrocoagulation method were effective in reducing pain, showing a significant decrease in pre- and postoperative VAS scores. In a study in which matricectomy was performed with surgery and phenolization, a chemical method, the methods showed similar VAS scores, recovery and return to work times and pain was significantly reduced in both [16]. Similarly, the study by Amarin et al. demonstrated that electrocauterization had a higher success rate, better patient satisfaction, and was a safe treatment method, although it had no effect on postoperative

pain scores or recovery time [11]. In contrast to other studies, Ozan et al. compared curettage matricectomy with coagulation matricectomy, finding that the curettage method was more effective in reducing inflammation and pain duration than electrocauterization [17]. In our study, although preoperative VAS scores were similar between the two groups, a statistically significant greater decrease in postoperative VAS scores was observed in the coagulation group. Unlike others, our study differs in this aspect.

In our study, both groups were compared in terms of demographic data, including age, gender distribution, affected toenail side, and Heifetz staging, with no significant differences observed between them. Similar studies, have also shown that the groups were statistically comparable in terms of demographic characteristics [4, 7]. This suggests that the outcomes of the different methods applied were not significantly influenced by demographic factors, allowing for a more focused evaluation of the surgical techniques. Romero-Pérez et al. suggested that a treatment for ingrown toenails can be considered effective if there is no recurrence within 6 months following the procedure [18]. In light of this, our study included patients with a minimum follow-up period of one year, ensuring a more thorough evaluation and enhancing the reliability and accuracy of the results. While recurrence, infection, and patient satisfaction were similar between the modified Winograd method and matrix electrocoagulation, the electrocoagulation group demonstrated faster return to activity and lower postoperative VAS scores. The Winograd method, which involves a skin incision and suturing requiring postoperative suture removal, may lead to cosmetic issues, whereas the electrocoagulation method, a minimally invasive procedure performed through a small subcutaneous puncture without skin incision, results in fewer cosmetic concerns.

This study has several limitations. Being retrospective, it is prone to missing or inaccurate data. The lack of randomization may have introduced biases related to socioeconomic factors and other variables. Conducting the study at a single center limits the generalizability of the findings. Subjective measures, such as patient satisfaction and pain scores, may have been influenced by personal perceptions and expectations. Lastly, the limited sample size can be attributed to the inclusion criteria, the retrospective design, and the infrequent application of electrocoagulation due to physical constraints and limited resources.

## Conclusion

Both treatment methods were found to be safe and effective. However, due to its advantages of reduced postoperative pain and quicker return to daily activities, partial nail resection with matrix electrocoagulation may be the preferred choice for patients. To confirm these findings, further prospective randomized studies involving larger sample sizes and diverse populations are needed.

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**Author contributions**
All authors contributed to the study conception and design. S.K. were responsible for the idea and concept of the paper. Material preparation, data collection and analysis were performed by S.K., A.O. The first draft of the manuscript was written by S.K. and all authors commented on previous versions of the manuscript. S.K., A.O. critically reviewed and revised the manuscript. All authors read and approved the final manuscript.

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**Availability of data and materials**
All data from this study are available upon reasonable request to the corresponding author.

## Declarations

**Ethics approval and informed consent**
The study adhered to the ethical principles outlined in the Declaration of Helsinki (1964). Approval was obtained from the Ethics Committee of Kanuni Sultan Suleyman Training and Research Hospital, Istanbul University of Health Sciences. Informed consent was obtained from all participants in the form of written consent. Informed consent was obtained from all participants prior to the collection of clinical and photographic data. Additionally, consent for the publication of personal data was secured before drafting the manuscript.

**Competing interests**
The authors declare no competing interests.

**Artificial intelligence**
No artificial intelligence was used for the writing of the submitted work.

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## Publisher's Note