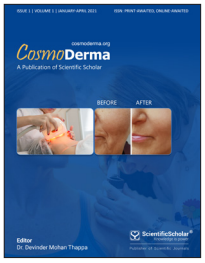
www.cosmoderma.org

ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

CosmoDerma



Original Article

Therapeutic efficacy of radiofrequency ablation in an ingrown toenail: A dermatologist domain – A prospective interventional study

Mandeep Singh[1], Shashank Tyagi[2], Mohita Mahajan[1], B. B. Mahajan[1]

[1]Department of Dermatology, Government Medical College, Amritsar, Punjab, [2]Department of Dermatology, Autonomous State Medical College, Pilibhit, Uttar Pradesh, India.

***Corresponding author:**
Mohita Mahajan,
Department of Dermatology,
Government Medical College,
Amritsar, Punjab, India.

mohitamahajan96@gmail.com

Received: 18 February 2025
Accepted: 30 March 2025
Published: 26 April 2025

DOI
10.25259/CSDM_36_2025

Quick Response Code:

ABSTRACT

Objectives: An ingrown toenail is a common and painful nail disease among adolescents and young adults. Despite innumerable treatment options, the ideal technique with complete resolution of signs and symptoms and a low recurrence rate still remains an elusive option. Hence, this study was conducted to evaluate the therapeutic efficacy of radiofrequency ablation in ingrown toenails and to study its role in preventing the recurrence of ingrown toenails.

Materials and Methods: A total of 30 patients with 33 ingrown toenails were enrolled in the study. All cases were diagnosed based on clinical examination followed by routine and specific investigations. Staging of ingrown toenails was done by Mogensen classification into stages I, IIa, IIb, and III. Then, the procedure of radiofrequency ablation was done and patients were followed up for 12 weeks. Statistical analysis was done using the Statistical Package for the Social Sciences 19.0 version (with $P < 0.05$ kept as significant).

Results: At 12 weeks, 30 nails out of 33 involved nails showed complete recovery (grade 3 improvement) after radiofrequency ablation, and one nail showed moderate recovery with grade 2 improvement. One nail did not respond to the procedure while one nail reverted to grade 0 improvement at 3 weeks of follow-up period. Recurrence occurred in only 1 (3%) out of 33 treated nails. The overall cure rate was 91%.

Conclusion: Radiofrequency ablation being safe, effective, and cosmetically acceptable with complete remission can be used as the preferred treatment option in all stages of ingrown toenails.

Keywords: Ingrown toenail, Mogensen classification, Radiofrequency ablation

INTRODUCTION

An ingrown toenail is a common and painful form of nail disease among adolescents and young adults. It is also known as unguis incarnates or onychocryptosis (from Greek; onyx – nail and kryptos – hidden).[1] The condition most commonly involves the great toe. Male-to-female ratio is 2:1.[2] The various risk factors implicated in its etiopathogenesis include wearing tight-fitting shoes or socks, improperly trimmed toenails, trauma to the nail plate or toe, excessive sweating and poor foot hygiene, nail infections, diabetes mellitus, and drugs such as retinoids, docetaxel, cyclosporine, and oral antifungals.[3,4]

As the exact etiology of ingrown toenails is unknown, various theories have been proposed to explain it and they can be broadly classified according to whether the primary fault is in the

nail itself or lateral nail fold.[5,6] The widely accepted theory is that an ingrown toenail occurs when the lateral nail fold is penetrated by the edge of the nail plate, resulting in pain, sepsis, and later formation of granulation tissue.[7]

Despite innumerable treatment options, e.g. cotton wick method, taping method, dental floss technique, or nail avulsion, etc., the ideal technique with a low recurrence rate still remains an elusive option. Hence, this study was carried out to evaluate the therapeutic efficacy of radiofrequency ablation and its role in preventing the recurrence of ingrown toenails.

MATERIALS AND METHODS

This prospective interventional study was carried out in the Dermatology department of a tertiary care center in North India over a period of two years. Approval was taken from the institution and ethics committee. Details of the procedure were explained and written consent was taken from all the patients. A total of thirty patients, both males and females of age group 15–45 years having ingrown toenails presenting to the dermatology outpatient department, were included in the study. Patients with active bacterial or fungal infections and with peripheral vascular diseases were excluded from the study. Staging of ingrown toenails was done based on Mogensen's classification into stages I, IIa, IIb, and III.[8] All stages of ingrown toenails were taken up. On the first visit, the toenail was clinically examined for any bacterial infection, if present patient was given antibiotics and anti-inflammatory treatment for 5–6 days. After being clear of any other infection, it was cleaned with a povidone-iodine solution. Proximal digital anesthesia with 2% lignocaine was given, followed by exsanguination and tying a tourniquet around the proximal part of the toe to minimize any bleeding. Then, the nail plate of the ingrown toenail was separated from lateral and proximal nail folds using a nail separator. The nail plate was cut at the cutting mode of the radiofrequency surgical unit extending from the free edge of the nail to the nail matrix and 3 mm proximal to the lateral nail fold. The lateral nail segment (3 mm) was removed using straight hemostatic forceps. A gutter thus formed between the nail plate and lateral nail fold was cleaned thoroughly with normal saline and curetted with a curette to remove any nail fragments. The lateral nail fold and nail matrix of the ingrown toenail was cauterized at coagulation mode using the probe of a radiofrequency surgical unit. In stage III ingrown toenails, granulation tissue is first cut followed by cutting of the nail plate. The nail matrix was cauterized using six cycles of coagulation mode. Each cycle lasted for 06 s. Postoperatively, a povidone-iodine solution gauze dressing was applied along with an oral antibiotic and painkiller for 5 days. The patients were advised for leg elevation for 1–2 days and to avoid wearing shoes for 3 days. They were advised to remove the dressing on the next day of the procedure followed by povidone-iodine solution cleansing and warm normal saline soaks for 10 min, twice daily for a week. Topical mupirocin 2% cream application was advised after that. The patients were called for follow-up on the 7th day.

Patients were followed up at weekly intervals up to the first four weeks and then at two weekly intervals for the next eight weeks, completing a total period of 12-week follow-up. All the treated ingrown toenails were assessed clinically as well as photographically at the baseline before subjecting to a radiofrequency procedure and at each follow-up [Figures 1-3].

The therapeutic response was determined as grade 0 = no improvement; grade 1 = up to 50% improvement in pain, swelling, and granulation tissue; grade 2: 51–75% improvement in pain, swelling, and granulation tissue; and grade 3: more than 75% improvement in pain, swelling, and granulation tissue.

RESULTS

A total of 33 nails of 30 patients were enrolled in the study as three patients had bilateral nail involvement. In one patient, both nail folds were involved. Maximum, sixteen (49%) nails were severely involved, i.e., in stage III, followed by stage IIa in eight (24%), stage I in five (15%), and stage IIb in four (12%) nails [Table 1].

Results of radiofrequency on different grades of ingrown toenails

Stage I

All five ingrown nails responded to radiofrequency ablation. Four nails (out of five) showed grade 1 and one nail showed grade 3 improvement to radiofrequency ablation at the end of 1st week. At 12 weeks, grade 3 improvement was seen in all five nails. None out of five nails showed any recurrence of the condition during the 12-week follow-up period.

Stage II

a. All the eight involved nails showed grade 1 improvement to radiofrequency ablation at the end of 1st week. At 12 weeks, grade 3 improvement was seen in seven nails and one nail showed grade 2 improvement. No nail showed recurrence during the follow-up period.
b. All four nails showed mild improvement in symptoms after the procedure at the end of 1st week. At 12 weeks, grade 3 improvement was seen in all four nails and none showed any recurrence of the condition during the 12-week follow-up period [Figure 4].

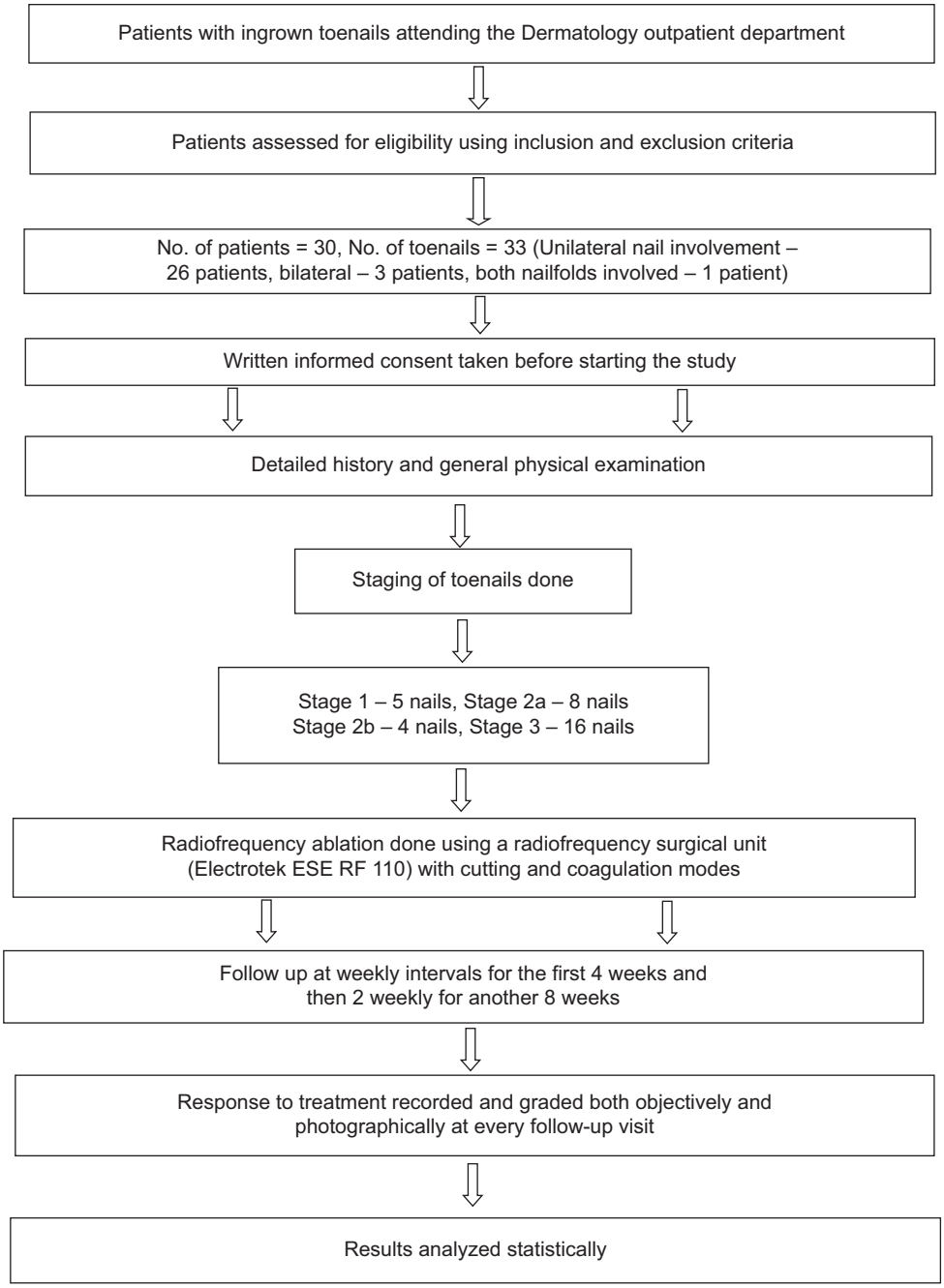


Figure 1: Study design. OPD: Outpatient department.

Stage III

Thirteen nails (out of sixteen) showed mild-to-moderate improvement in symptoms after radiofrequency ablation at the end of 1st week. Two nails showed grade 3 improvement at the end of 1st week whereas one nail (with both nail folds involved) showed no improvement. One nail (patient with bilateral ingrown toenail) reverted to grade 0 improvement after 3 weeks of follow-up. At 12 weeks, two nails had grade 0 improvement whereas all other fourteen nails showed grade 3 improvement and did not show recurrence during the follow-up period [Figures 5 and 6].

Hence, at 12 weeks, 30 nails (91%) out of 33 treated nails showed complete recovery (grade 3 improvement) after radiofrequency ablation, and one nail showed moderate recovery with grade 2 improvement. One nail (with stage III involvement) did not respond to the procedure while one nail reverted to grade 0 improvement after 3 weeks [Table 2]. Nail avulsion with phenol application was done

Figure 2: Procedure of cutting of nail plate with the probe of radiofrequency surgical unit at the cutting mode extending from the free edge of the nail till the nail matrix and 3 mm proximal to the lateral nail fold.

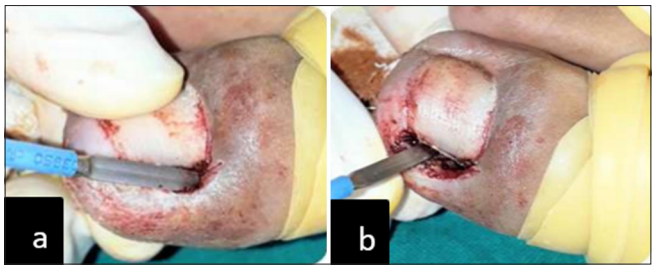


Figure 3: (a and b) Procedure of cauterization of nail matrix and lateral nail fold at coagulation mode using probe of radiofrequency surgical unit.

in all non-responders. Hence, overall, the cure rate in the study is 30 (91%) out of 33 nails which is more than other studies treating ingrown toenails with different methods.[9,10] Recurrence occurred only in one (3%) out of 33 treated nails.

Adverse effects were minimal. Ten patients had serous discharge with mild pain [Table 3]. These adverse effects may be due to secondary infection. These were managed with oral antibiotics along with normal saline soaks twice daily for 10 days and gentian violet 1% paint in spirit for local application. Two patients had transient post-procedure hyperpigmentation over the nail plate [Figure 7]. Rest all, 18 patients did not show any adverse effects.

DISCUSSION

An ingrown toenail is one of the most frequent nail disorders of young persons. It may negatively influence daily activities and cause discomfort and pain. Correct management of onychocryptosis requires identification of the stage and evaluation of the affected tissues. According to the Mozena classification. Grade 1 requires a conservative approach. Grade 2 often requires partial matricectomy, whereas, for

Table 1: Staging of ingrown toenail at baseline.

Stage	Number	Percentage
Stage I	05	15.15
Stage II a	08	24.24
Stage II b	04	12.12
Stage III	16	48.48
Total Nails	33	100

Table 2: Number and percentage of nails from different stages showing grade 3 improvement at week 12.

Stages of involvement	Number of nails in different stages	Number and percentage of nails showing grade 3 improvement at the end of 12 weeks
Stage I	05	05 (100)
Stage II a	08	07 (87.5)
Stage II b	04	04 (100)
Stage III	16	14 (87.5)
Total	33	30 (91)

Table 3: Adverse effects.

Adverse effect	Number	% age
Serous discharge and mild pain	10	33.33
Post-procedure hyperpigmentation of nail	02	6.67
No adverse effect	18	60.00
Total	30	100.00

grades 3 and 4, treatment is surgical intervention, namely partial nail plate avulsion with matricectomy or wedge resection.[11] Total nail avulsion is mainly done for recurrent onychocryptosis, surgical relapse, and failure of conservative treatment.

Matricectomy can be performed by either chemical or mechanical destruction. Chemical matricectomy is usually performed with the help of phenol (88%), trichloroacetic acid (100%), and sodium hydroxide (10%). Although chemical matricectomy is a simple and inexpensive technique, healing time is relatively longer along with unpredictable collateral tissue damage and prolonged drainage resulting from epidermal slough caused by the chemical burn and the possible infection.[12,13]

Matricectomy by surgical excision has a low recurrence rate but is tedious and a lengthy procedure. It is associated with higher postoperative pain and prolonged drainage.[14] Mechanical matricectomy can also be performed with the help of carbon dioxide (CO_2) laser,[15] and cryotherapy[10]

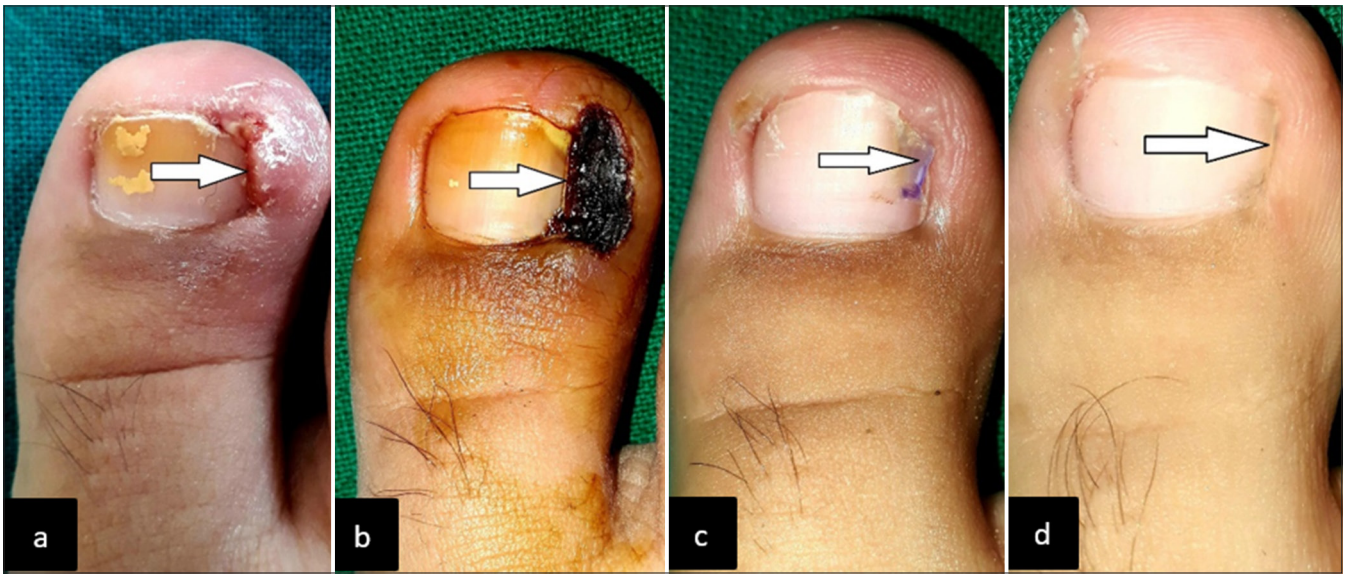


Figure 4: Showing grading of improvement in stage IIb ingrown toenail. (a) Week 0 (white arrow showing erythema, edema, and infection over the lateral nail fold). (b) Week 1 (white arrow showing scab formation over the lateral nail fold). (c) Week 4 (white arrow showing reduction in erythema, edema, and infection over the lateral nail fold). (d) Week 12 (white arrow showing complete resolution of edema, erythema, and infection over the lateral nail fold with grade 3 improvement).

Figure 5: Showing grades of improvement in stage III ingrown toenail. (a) Week 0 (showing stage III ingrown toenail with hypergranulation tissue). (b) Week 1 (showing scab formation over the lateral nail fold). (c) Week 12 (showing complete resolution of hypergranulation tissue with grade 3 improvement).

offers effective and selective destruction of the nail matrix than chemical matricectomy but it is very expensive and requires technical expertise. High cost of laser, prolonged healing time, and poor cosmetic outcome limit the use of this technique. Hence, an ideal technique with a low recurrence rate, low downtime, and high cosmetic acceptability is still to be elucidated. In the present study, an attempt to find a better alternative for ingrown toenail in the form of electrosection with radiofrequency surgical unit was done, which is simple, cost effective (poor man's laser), and cosmetically acceptable and most importantly with low recurrence rate.

Radiofrequency ablation is a faster, less painful option that causes selective tissue damage. There is less lateral heat spread and tissue damage with better control. Recurrence rate is lower and healing is faster with this technique. It has been shown to be more effective and versatile in comparison to the CO_2 laser.[16]

Our study showed a success rate of 91% after radiofrequency ablation at 12-week follow-up period [Figure 8]. Recurrence occurred only in one (3%) out of 33 improved nails, which is similar to the study done by Singal and Kaur in which 10 nails treated with partial nail avulsion with matricectomy by radio-frequency ablation showed faster healing within a week time, no recurrence after 3–5-month follow-up period and a significant reduction in ooze, pain, and swelling.[16] Other studies showing treatment with different methods showed higher recurrence rate as done by Gupta *et al.* on nail splinting with a longitudinally incised plastic tube to evaluate the efficacy and safety of this procedure in 50 patients (68 nail edges in 61 nails) with ingrown toenails, and recurrence was seen in eight (20.5%) patients.[9] Other therapies such as Band-Aid method, Dental floss, nail splinting, and partial or complete nail avulsion were also associated with high recurrence rate, while complete nail avulsion with penalization seems to be treatment modality with high cure rate and least recurrence rate but it is cumbersome procedure with need of surgical efficiency and is cosmetically less acceptable.[17,18]

Hence, radiofrequency ablation has got all the potentials to be a very good treatment modality for ingrown toenails as it is safe, cost-effective, and without any significant side effect and can be used in any age group.

Figure 6: Showing grades of improvement in stage III ingrown toenail. (a) Week 0 (showing stage III ingrown toenail with hypergranulation tissue). (b) Week 1 (showing scab formation over the lateral nail fold). (c) Week 4 (showing complete resolution of hypergranulation tissue). (d) Week 12 (showing grade 3 improvement).

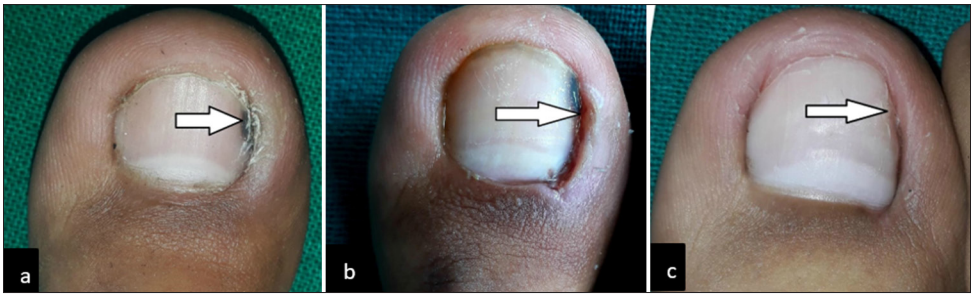


Figure 7: (a-c) Showing transient post-procedure hyperpigmentation as adverse effect at the lateral nail fold (white arrow), which goes away with the growth of the nail plate.

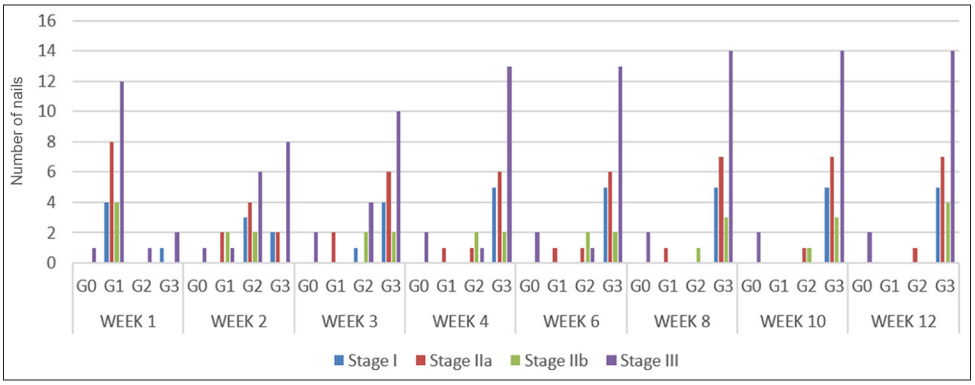


Figure 8: Graph showing response to treatment of different stages of ingrown toenail over a period of 12 weeks.

Limitations of study

No controls have been kept, as this condition is painful and needs to be dealt with as early as possible. Sample size and follow-up period of 3 months were short as only 30 patients for 12 weeks were enrolled; so larger sample size for longer follow-up period could have given more conclusive results. As there were no set guidelines for radiofrequency ablation

in ingrown toenail, the number of cycles and duration to coagulate nail matrix were decided empirically. Comparative study was not done as each nail and each person are different and response depends upon various other factors such as shoe habits, age, and other preventive measures.

CONCLUSION

Radiofrequency ablation has been found to be an effective, safe, cost-effective, and cosmetically acceptable therapeutic modality with lower complications and recurrence rate not only for treatment but also preventing recurrence in all stages of ingrown toenail. Hence, it is another therapeutic pearl in the hands of expert dermatologists and can therefore be used as an alternative method in surgical management of ingrown nail.

Ethical approval: The research/study was approved by the Institutional Review Board at Government Medical College Amritsar, number BFUHS/2K18p-TH/729, dated January 17, 2019.
Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal.
Financial support and sponsorship: Nil.
Conflicts of interest: There are no conflicts of interest.
Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. James WD, Berger TG, Elston DM. Andrews' diseases of the skin: Clinical dermatology. 10th ed. Philadelphia, PA: Saunders; 2005. p. 789.
2. Langford DT, Burke C, Robertson K. Risk factors in onychocryptosis. Br J Surg 1989;76:45-8.
3. Nicolopoulos J, Howard A. Docetaxel-induced nail dystrophy. Australas J Dermatol 2002;43:293-6.
4. Weaver TD, Jespersen DL. Multiple onychocryptosis following treatment of onychomycosis with oral terbinafine. Cutis 2000;66:211-2.
5. Rounding C, Bloomfield S. Surgical treatments for ingrowing toenails. Cochrane Database Syst Rev 2003;2:CD001541.
6. Chapeskie H. Ingrown toenail or overgrown toe skin?: Alternative treatment for onychocryptosis. Can Fam Physician 2008;54:1561-2.
7. Baran R, Haneke E, Richert B. Pincer nails: Definition and surgical treatment. Dermatol Surg 2001;27:261-6.
8. Mogensen P. Ingrowing toenail. Follow-up on 64 patients treated by labiomatricectomy. Acta Orthop Scand 1971;42:94-101.
9. Gupta S, Sahoo B, Kumar B. Treating ingrown toenails by nail splinting with a flexible tube: An Indian experience. J Dermatol 2001;28:485-9.
10. Sethi N, Brar BK, Mahajan BB. Superficial cryotherapy-an effective therapeutic modality for ingrown toenail. J Pak Assoc Dermatol 2018;27:149-53.
11. Martinez-Nova A, Sanchez-Rodriguez R, Alonso-Pena D. A new onychocryptosis classification and treatment plan. J Am Podiatr Med Assoc 2007;97:389-93.
12. Baran R, Haneke E. Matricectomy and nail ablation. Hand Clin 2002;18:693-6, 8, discussion 697.
13. Karaca N, Dereli T. Treatment of ingrown toenail with proximolateral matrix partial excision and matrix phenolization. Ann Fam Med 2012;10:556-9.
14. Khunger N, Kandhari R. Ingrown toenails. Indian J Dermatol Venereol Leprol 2012;78:279-89.
15. Ozawa T, Nose K, Harada T, Muraoka M, Ishii M. Partial matricectomy with a CO_2 laser for ingrown toenail after nail matrix staining. Dermatol Surg 2005;31:302-5.
16. Singal A, Kaur I. Radio-frequency ablation for matricectomy in the management of ingrown toenail: A pilot study. J Cutan Aesthet Surg 2019;12:212-4.
17. Nazari S. A simple and practical method in treatment of ingrown nails: Splinting by flexible tube. J Eur Acad Dermatol Venereol 2006;20:1302-6.
18. Woo SH, Kim IH. Surgical pearl: Nail edge separation with dental floss for ingrown toenails. J Am Acad Dermatol 2004;50:939-40.

How to cite this article: Singh M, Tyagi S, Mahajan M, Mahajan BB. Therapeutic efficacy of radiofrequency ablation in an ingrown toenail: A dermatologist domain – A prospective interventional study. CosmoDerma. 2025;5:50. doi: 10.25259/CSDM_36_2025