

A new perspective on the nail plate for treatment of ingrown toenail

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ABSTRACT **Background:** Our routine treatment for ingrown toenail was removal of the surrounding soft tissue and shortening the bone of the distal phalanx. We determined the range and volume of excision based on our experience without an objective standard and routinely performed avulsion of the nail plate.

Objective: To take the nail plate as an objective mark during surgical treatment of ingrown toenail to ensure accurate excision.

Patients and Methods: Fifteen patients with ingrown toenails were treated with this technique. We used the lateral borders of the nail plate as a landmark to determine the volume of soft tissue surrounding the nail plate and distal phalanx to be removed. No avulsion of nail plate was performed.

Results: No recurrence was observed during the follow-up period, which ranged from 24 to 35 months (29.9 months on average). The visual analog scale for pain showed significant pain relief in the patients. The Vancouver Scar Scale showed acceptable cosmetic outcomes. The width of excised skin ranged from 3.5 to 6.2 mm (5.0 mm on average).

Conclusion: The use of the lateral borders of the nail plate as a landmark for surgical intervention of ingrown toenail offered excellent outcomes and reduced loss of healthy tissues.

Introduction

Ingrown toenail is a common condition among adolescents and young adults. Surgical intervention is usually recommended for stage 2 and stage 3 ingrown toenails as classified under the Heifetz and Mogensen system [1,2]. We have performed crescent excision of soft tissue, bony shortening of the distal phalanx, as well as nail avulsion for several years

[3], but have not defined an objective standard for excision of the soft tissue and distal phalanx. Moreover, routine nail avulsion seems obsolete. In recent years, we have found the nail plate itself to be a good landmark for more accurate excision. We were interested in seeing whether our patient could get a good result if the nail plate was not avulsed and used as an objective standard for excision of the soft tissue and distal phalanx. Our aim was to evaluate the outcomes following

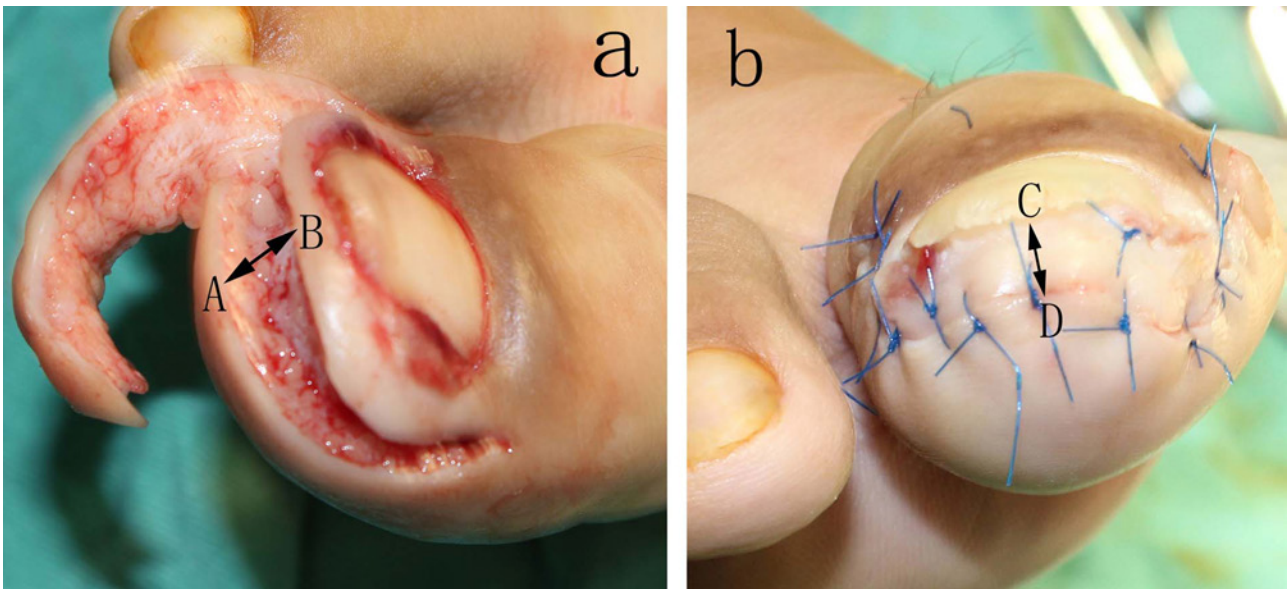


Figure 1. The width of excised skin (A, B) and the width of preserved skin (C, D). [Copyright: ©2018 Tian et al.]

ingrown toenail correction in patients who had undergone our surgical approach in terms of healing time, relief of pain, recurrence, and scar formation.

Patients and Methods

Fifteen patients with ingrown toenail, nine males and six females (aged 12–35 years; 20 years of age on average) at stages 2 and 3, were included in this study. These surgeries were performed in our hospital between December 2013 and May 2015. This study was conducted in compliance with the World Medical Association Declaration of Helsinki on medical research ethics. All patients provided informed consent before surgery, and institutional review board approval was obtained.

All of them were affected on their great toes. Nearly half of the patients came to us after ineffective conservative treatment. Patients who had onychomycosis were treated with miconazole and soaking the affected area in warm water with potassium permanganate solution (1:5000) 30 minutes per day for two weeks. Patients with acute infection were treated with oral antibiotics, with the addition of topical antibiotics when necessary. Their nail plates were not avulsed for drainage. The operation was performed in the operating room approximately one week after resolution of the inflammation.

Povidone-iodine solution was used to disinfect the affected foot. All patients underwent local anesthesia with 1% lidocaine. The local anesthetic was administered circumferentially at the base of the hallux to block the plantar digital nerves and the ending sensory branches of the deep and superficial peroneal nerves. A tourniquet was fastened at the base of the hallux to occlude circulation. Before making incisions, we explored the lateral nail borders to evaluate the width

of the nail plate buried in the bulky tissue, which would be used as a reference to decide how much of the soft tissue to resect. After that, an incision was made 2–3 mm distal to the hyponychium on the toe tip and then extended proximally parallel to both sides of the nail folds to the base of the toenail. The next incisions would be performed along the first incision (Figure 1). The incision was made deep enough to the periosteum of the distal phalanx. We performed a distal phalanx shortening to achieve primary wound closure with no tension. We transected the distal phalanx meticulously to avoid damage to the supporting structures of the nail bed, taking care to avoid injuring the neurovascular bundles as well. We retracted the bulky tissue overlapping the nail plate downwards to check whether it was sufficient to expose the lateral borders of the nail plate. We would stop resecting skin around the nail when it was enough to expose the borders of the nail plate after closing the wound (Figure 2). If the granulation tissue overlapping the nail plate was too bulky, we trimmed it to expose the lateral borders of the nail plate if necessary (Figure 3). The defect was closed using interrupted 4-0 polypropylene sutures. The tourniquet was released and the wound was covered with petrolatum gauze to avoid adhesion of the dressings to the wounds. The dressings were changed every two days for two weeks; the sutures were then removed. The patients were taught to wear proper shoes and trim their nails correctly.

Results

All patients returned to daily activity two weeks after surgery. There was no recurrence of ingrown toenail during the follow-up period. We used the visual analog scale for pain to assess pain relief in our patients about three months

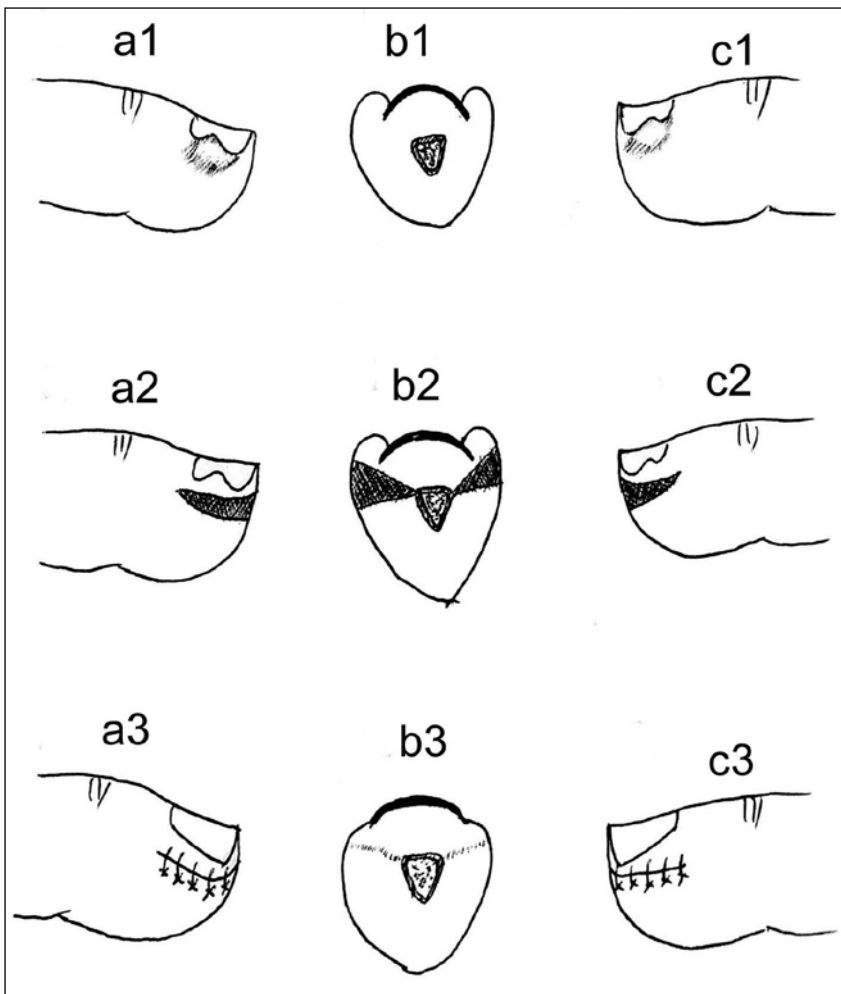


Figure 2. Illustration of the technique in the lateral and transverse views. [Copyright: ©2018 Tian et al.]

after surgery and found the outcome to be satisfactory (Table 1). The width of excised skin ranged from 3.5 to 6.2 mm (mean 5.0 mm) (Table 1). We used the Vancouver Scar Scale to evaluate the scar formation 24–35 months after surgery. The median values of vascularity, scar height, pigmentation, and pliability were either 0 or 1 (Table 2). No patients experienced osseous inflammation after surgery. No patient had nail deformity or spicule formation.

Discussion

Patients with ingrown toenail experience pain, limitation of daily activities, and topical infections. Various surgical interventions have been introduced by surgeons for treatment of ingrown toenail, such as matricectomy [4,5], phenolization [6], Winograd technique [7,8], knot technique [9], and soft tissue resection without matricectomy [10,11]. Each intervention has certain advantages and disadvantages based on the clinical scenario.

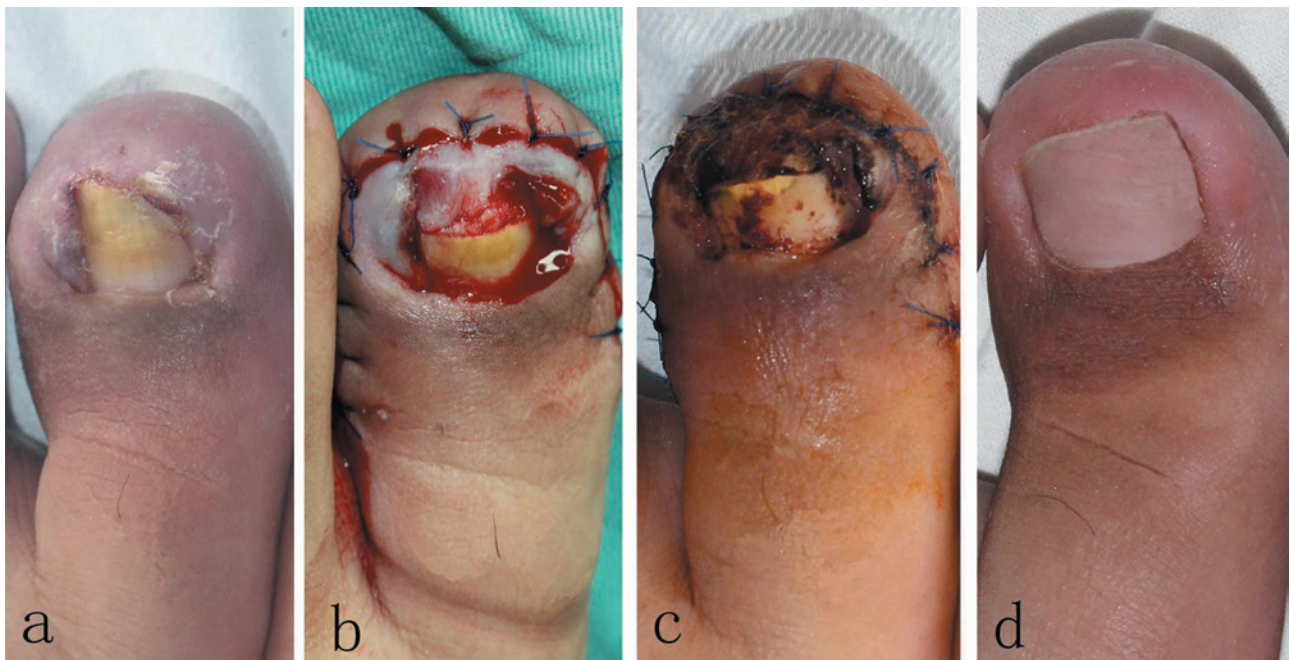


Figure 3. Preoperative and postoperative views of a case with ingrown toenail. (a) The involved toe with bulky granulation tissue overlapping the nail plate. The yellow color on the nail plate was due to iodine solution used by the patient himself. (b) The wound was closed with no tension. Almost one-third of the nail plate was removed from the distal edge to trim the bulky granulation tissue completely for a better exposure of the lateral nail borders. (c) One week after surgery. There was no further bleeding, but a little oozing. (d) 25-month postoperative view. The nail plate was normal in appearance with no recurrence. [Copyright: ©2018 Tian et al.]

TABLE 1. Patients and follow-up outcomes

Patient	Age (years)	Sex	Involved digits (hallux)	Follow-up period (months)	VAS		Width of excised skin (mm)	Recurrence
					Before surgery	after surgery		
1	13	M	left	27	4	0	4.1	no
2	22	M	right	33	6	0	5.3	no
3	15	F	right	34	5	0	5.6	no
4	33	M	left	25	7	0	6.2	no
5	21	F	right	34	5	0	5.7	no
6	16	F	right	35	6	0	6.1	no
7	12	F	both	31	5	0	4.4/4.1	no
8	17	M	both	32	4	0	5.6/5.3	no
9	23	M	left	30	4	0	3.5	no
10	25	M	left	24	7	1	5.8	no
11	14	F	left	27	6	0	4.3	no
12	15	M	right	35	6	0	5.3	no
13	19	M	both	29	4	0	5.2/5.3	no
14	35	F	right	26	6	0	4.2	no
15	22	M	right	26	5	0	5.6	no

Abbreviation: VAS, Visual Analog Scale for Pain.

TABLE 2. Numerical scale of VSS used for assessment of scar formation

Score (points)	Pigmentation	Vascularity	Pliability	Height
0	Normal	Normal	Normal	Normal to flat
1	Hypopigmentation	Pink	Supple	0-1 mm
2	Mixed pigmentation	Red	Yielding	1-2 mm
3	Hyperpigmentation	Purple	Firm	2-4 mm
4			Banding	>4 mm
5			Contracture	
Median value (range) n=15	1(0-2)	0(0-1)	1(0-3)	0(0-1)

Abbreviation: VSS, Vancouver Scar Scale.

Ingrown toenail is caused by the conflict between the nail plate and the soft tissue. There must be something unbalancing the relationship, whether it is the ingrown toenail or the overgrown toe skin [12]. Córdoba-Fernández et al. showed that abnormal hallux interphalangeal angle increases the risk of ingrown hallux nail [13], but other potential causes remain unclear. The primary aim of most surgeries is to prevent interference between the nail and the soft tissue. Many surgeons have prioritized treatments of the nail, such as nail avulsion. Other surgeons instead recommend resection of

soft tissue, which leaves the nail matrix intact [14]. We had also performed soft-tissue resection for several years. We had not hesitated to perform nail plate avulsion, partly because we understood that the removal would aid in drainage of the infection. Afterwards, we realized the important role of the nail plate in the surgical intervention and used them to define an objective standard to perform an accurate excision. Meanwhile, we were convinced that the drainage enhancement afforded by avulsion was largely unnecessary due to the usual thorough reduction of inflammation through other

means. Therefore, we considered that the risk of incomplete damage might be outweighed by the benefit of preserving more healthy tissue.

The goals of our approach are to offer our patients a great relief of pain with shorter recovering time, an aesthetic appearance, and no recurrence in the future. Resection of skin surrounding the nail means removing an adequate amount of soft tissue to eradicate the possible causes of recurrence associated with bilateral and distal nail folds. On the other hand, resection of skin surrounding the nail also plays an important role in keeping the new bilateral and distal nail folds in a symmetric position, which will influence the aesthetic appearance if asymmetric nail folds appear. As we know, primary wound closure with no tension is critical for healing in a short time and for lowering the risks of dehiscence and scarring. Resection of skin at the toe tip can make it easier to shorten the distal phalanx, which is necessary to achieve primary wound closure with no tension. As a matter of fact, bone shortening is inconspicuous and most patients do not perceive any change in the toe. Generally speaking, our patients can get an acceptable result from this procedure without any severe complications.

There are several advantages of this technique, and they are as follows:

1. Shorter time period needed to regain daily activities. Primary healing can be achieved in almost all patients. It usually takes two weeks for wound healing after surgery.
2. No observed recurrence, indicating that the technique may have eradicated the factors that unbalanced the relationship between the nail plate and soft tissue.
3. No narrowing of the nail plate. The key point of this technique is to reserve the nail plate, rendering it unnecessary for the patient to worry about the narrowing of the nail plate postoperatively.
4. No damage to the nail matrix. We do not perform ablation of the nail matrix to limit the growth of the nail, resulting in a normal-looking toe after recovery.
5. Acceptable scarring. Scar formation is acceptable due to the wound closure with no tension.

The disadvantages of this technique include:

1. Necessity of shortening the bone of the distal phalanx, which some patients may not have understood.
2. Pain, which is caused by the large and deep defects necessary to treat the toe, and is obvious to most patients in two or three days after surgery and mitigated with analgesics.
3. Risk of osseous infection, which might have been transmitted through the transection defect, especially in patients with severe infections. The latter is mitigated with sensitive management of inflammation, which is critical for our patients to avoid severe complications after surgery.

4. Risks of poor vascularity and necrosis for the thin skin strip along the nail plate. No thinner than 2 mm is safe in our experience.

This technique is not an appropriate treatment for all kinds of ingrown toenail. Patients with congenital nail deformity or diabetes mellitus are not encouraged to be treated with this procedure. Patients with nonstandard presentation sometimes required personalized treatment, and avulsion of the nail plate was unavoidable in certain cases [15]. This technique has been considered to be quite invasive with substantial postoperative pain, risk for bone infection and downtime compared to other common treatments such as gutter-splint treatment or phenolization and is therefore only indicated for a relatively small number of patients. Usually only those teenagers who were eager to get back to school would accept it unhesitatingly in our practice. Some patients did not consider the ingrown toenail to be a serious problem and were intimidated by the details of the procedure. It is easy to understand why simple avulsion of the nail plate was so popular despite its poor effectiveness.

Although our sample size was small and follow-up period short in our reported series, we believe that soft tissue excision guided by the lateral borders of the nail plate combined with bony shortening of the distal phalanx is an effective treatment for ingrown toenail. Given our promising results, further research is warranted, more patients should be treated, and a longer follow-up period tracked to overcome the limitations of our small study. The technique's several advantages, including the short healing time, excellent aesthetic appearance, and lack of any recurrence, could benefit many more patients with ingrown toenail in the future.

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