Soft-Tissue Nail Fold Arc Resection Combined with a Shaped Dressing for Ingrown Toenails

Pan Hu*
Yanhong Hu*

The objective of this study was to evaluate the effectiveness of the surgical method of arc resection of soft-tissue nail fold combined with a shaped dressing for ingrown toenails. The surgical method involved the excision of nail fold granulation tissue and partial or total nail avulsion with preservation of its matrix. This surgical approach was applied to 20 consecutive patients (age range, 11–30 years) admitted to the hospital from January 1, 2014, to December 31, 2015. For assessment of the method, the operative technique, dressing change, and postoperative wound healing were recorded by photography. Finally, we evaluated the therapeutic effects by calculating the recurrence rate and nail groove expansion rate. Twenty patients with 38 surgical sites in 26 toes were analyzed; there was no recurrence at 3, 6, and 12 months. There was a statistically significant difference in the groove expansion rate at different time points. We measured the wound distance on postoperative day 1 compared with the day of healing and found that the method of shaped dressing could expand the nail groove by more than 50% ($P \leq .05$). The mean $\pm$ SD recovery time was 15.1 $\pm$ 2.4 days. Arc resection of the nail folds for ingrown toenails coupled with preservation of its matrix minimizes trauma and is easy to manipulate. Applying a shaped dressing after the operation further reduces the risk of recurrence and ensures enough growth space for the toenails. (J Am Podiatr Med Assoc 110(4): 1-8, 2020)

Ingrown toenail is a common nail disease that is encountered frequently in outpatient practice. It may cause inflammation and infection, which could impair the ability to walk and work. Painful irritation, excessive granulation tissue formation, and nail groove disappearance are the main symptoms. It is reported that the incidence of this disease is higher in adolescents, with a reported age as young as 9 years.[1-3]

Nail avulsion via surgical correction is the preferred treatment for ingrown toenails. Wide-range resection of soft-tissue nail fold is one of many surgical techniques described in the literature for removal of ingrown toenails.[3-11] Vandenbos and Bowers[4] suggested that pressure necrosis of the soft tissue surrounding the nail contributes to the pathogenesis of ingrown toenails, and they were the first to conduct wide-range resection of soft-tissue nail fold for ingrown toenail. Pearson et al[5] found no significant difference in nail shape between affected nails and matched controls, suggesting that treatment should not be based on the correction of a "nonexistent nail deformity." Martínez-Nova et al[6,7] suggested that the nail groove reconstruction technique was needed when hypertrophy of the nail fold affecting the nail plate was greater than 3 mm. More recently, similar operative methods for wide-range resection of soft-tissue nail fold were reported by Chapeskie and Kovac,[8] Noël,[9] and Zhu et al,[10] who closed the defect with sutures after removing a large volume of soft tissue surrounding the nail plate. However, removal of deeply grown soft tissue may lead to loss of sensation around the area of surgery, possibly due to impairment of peripheral nerves by resection of deep soft tissues, resulting in a high risk of injury. In the present study we report a surgical approach, modifying the method described by Chapeskie and Kovac,[8] that removes soft-tissue nail fold without damaging the nail bed and matrix and applies a shaped dressing to rebuild the nail groove postoperatively. We undertook a retrospective cohort study to determine whether the com-

*Outpatient Department, DaPing Hospital, Research Institute of Surgery, Third Military Medical University, Daping, ChongQing, China

Corresponding author: Yanhong Hu, Outpatient Department, DaPing Hospital, Research Institute of Surgery, Third Military Medical University, No. 10, Changjiang Branch Road, Daping, Yuzhong District, ChongQing, 400042 China. (E-mail: 13527500681@163.com)

bined approach could reduce the risk of loss of sensation and prevent recurrence.

Patients and Methods

The present study of 20 consecutive patients (age range, 11–30 years) who underwent surgical treatment of ingrown toenails was conducted from January 1, 2014, to December 31, 2015. One of us (P.H.) performed data consolidation and analysis and the other (Y.H.) performed all of the operations and measurements.

All of the patients receiving the treatment had detailed medical histories obtained before undergoing the surgical intervention, and no randomization was performed. The inclusion criteria for surgery were as follows: normal comprehension without nervous system disease, mental illness, or cognitive impairment; previous conservative treatment that failed (eg, shoe alterations, rest, and dressing changes; none of the patients had received antibiotic drug treatment); and nail fold soft-tissue hyperplasia over the toenails accompanied by infection, inflammation, bleeding, or drainage. Patients who had neural or cognitive dysfunction, women who were pregnant or nursing a baby, patients with thrombocytopenia and other bleeding risks, and patients with chronic osteomyelitis, diabetes, or peripheral vascular disease were excluded from the study. A consecutive cohort of patients was used (N = 20). Among them, four patients were previously treated with nail avulsions two to four times without resection of nail matrix or nail fold soft tissue; four patients were previously treated with surgical matricectomy, but one recurred after 1 month; and the other 12 patients had not received any surgical treatment previously. Most patients (16 of 20 [80%]) were younger than 20 years, and males constituted the majority (19 of 20 [95%]). The study was approved by the ethical committee of Daping Hospital, Army Medical University (ChongQing, China), and the included patients were fully informed and joined the study voluntarily and willingly.

Surgical Technique

We designed an operative approach based on the surgical method described by Chapeskie and Kovac[8] with the following modifications: the extent and depth of nail fold resection were narrowed, the skin on the base of the nail was reserved, arc resection was cut along the epithelium of the nail, and the depth of resection was controlled in the subcutaneous layer. Then we formulated a postoperative wound treatment plan for all of the patients, and a dressing change with positive pressure was used to extend the nail groove space. With the patient laying on the bed, the involved toe was disinfected with 2% tincture of iodine and 75% alcohol (if patients were allergic to iodine, 75% alcohol only was used), and all of the procedures were prepared in a sterile manner. Local anesthesia was applied with 5% lidocaine to the patient. The surgeon held the toe on both sides with thumb and forefinger to maintain a bloodless surgical field and then separated the nail and nail bed bluntly and pulled out the nail. An initial incision of the border nail fold was made proximally from the epithelial edge of the nail root to the tip to keep the nail matrix and bed intact. During the operation, the wound was created at a slightly lower position than the nail bed, and after the operation, the wound surface was maintained flat, which was the key to reducing recurrence. All of the skin and inflammatory tissues at the edge of the nail were removed, but the incision was stopped at the subcutaneous tissue to avoid the risk of postoperative sensation loss. Sterile saline was applied to clean the wound, and a hemostatic dressing (alginate) was pressurized on the wound to prevent postoperative bleeding. The wound was then allowed to close via secondary intention and observation for 20 min to assess whether the patient had pain, dizziness, or hemorrhage and to take corresponding measures in a timely manner. No antibiotic agents were prescribed before or after the operation. The soft-tissue nail fold excision procedure for ingrown toenails is given in Fig. 1.

Shaped Dressing Technique

Dressing changes began on the first day after the operation. The change was performed in a strictly aseptic manner. The skin around the wound was disinfected with 5% iodine (excluding those allergic to iodine, only sterile saline preparation). Sterile saline was applied to clean the wound, and a thick antimicrobial dressing was chosen to pressurize the wound to ensure flat growth on postoperative days 1 to 3. Thereafter we used a foam dressing (PermaFoam; Paul Hartmann AG, Heidenheim, Germany) to pressurize the wound until it healed. This approach enabled the wound to grow into a flat form and helped enlarge the groove space (Fig. 2).

Measurement of Distances

We measured the distance before and after dressing changes for every surgical side; four surgical sites



Figure 1. The soft-tissue nail fold excision procedure for ingrown toenails. A, Preoperative. B, The surgeon held the toe on both sides with thumb and forefinger to maintain a bloodless surgical field and then separated the nail and nail bed bluntly and pulled out the nail. C, An initial incision of the border nail fold was made proximally from the epithelial edge of the nail root to the tip to keep the nail matrix and bed intact. During the operation, the wound was created at a slightly lower position than the nail bed. D, After the operation, the wound surface was maintained flat, which was the key to reduce recurrence. All of the skin and inflammatory tissues at the edge of the nail were removed, but the incision was stopped at the subcutaneous tissues to avoid the risk of postoperative sensation loss. E, Sterile saline was applied to clean the wound, and a hemostatic dressing (alginate) was pressurized on the wound to prevent postoperative bleeding. F, Postoperative day 1. *(continued on next page)*

were measured. The distance between the outer edge of the wound and the toenail bed side (the width of the nail fold resection) was measured horizontally on day 1 after the operation. The distance between the healed nail fold and the toenail bed side (ie, nail groove) was measured horizontally on the day that the wound was healed (Fig. 3); because each patient's healing time was different, the measurement time ranges from postoperative day 13 to 20. All of the measurements were made by a single wound healer. The various distances and the position descriptions were made by the performer. We compared the two distances mentioned previously herein and evaluated the effect of shaped dressing change on the morphological features of the wound during healing after the operation.

Analysis Method

Patients were followed by telephone interview after 3, 6, and 12months by one of us (P.H.) to monitor recurrence and sensation. A paired t test was used to compare the measurements of two distances for the four sides of the surgical sites. A $P \leq .05$ was considered statistically significant. IBM SPSS Sta-

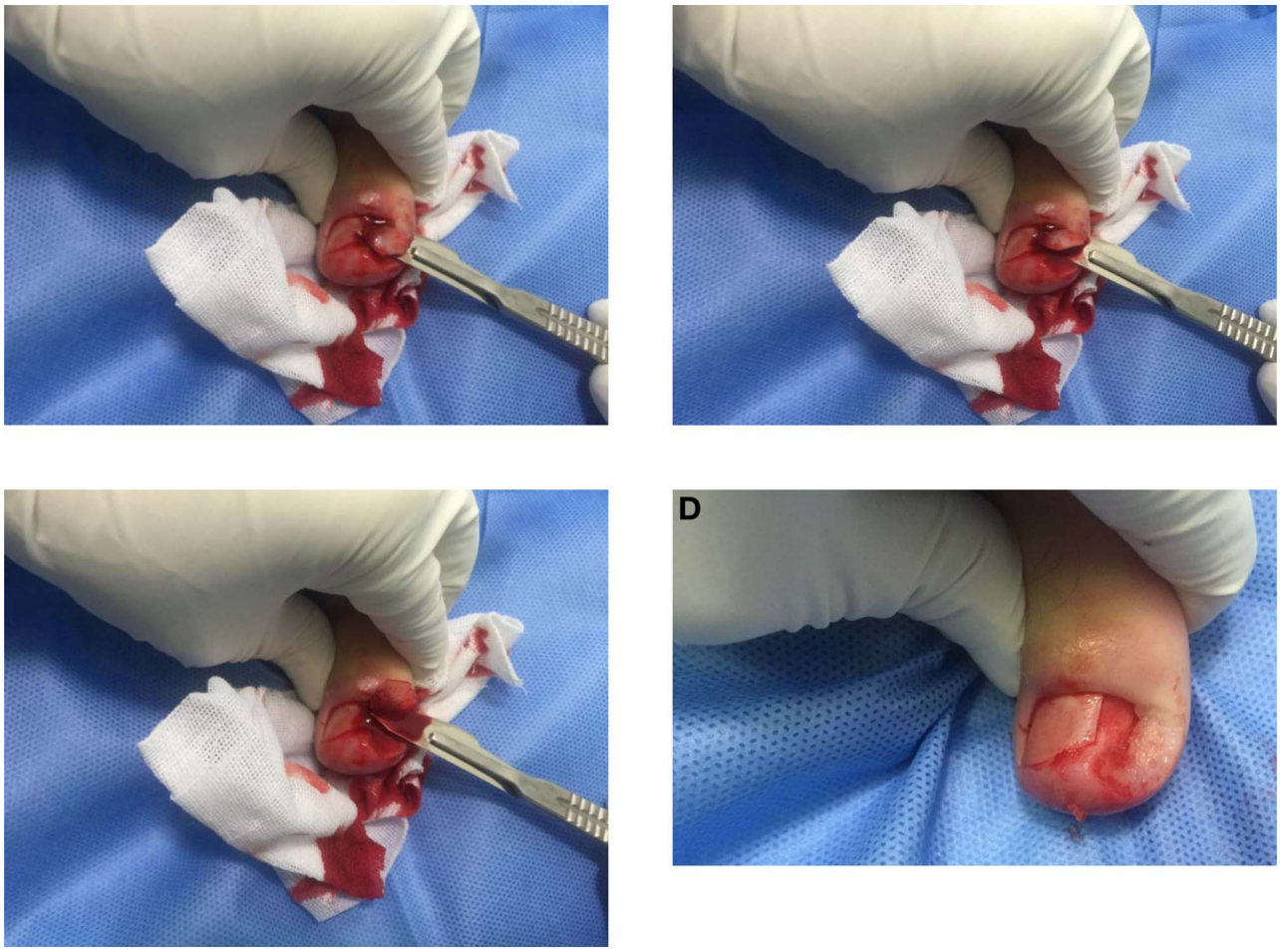


Figure 1. continued *(continued on next page)*

tistics for Windows, Version 18.0 (IBM Corp, Armonk, New York) was used for the statistical analysis.

Results

Based on the previously mentioned criteria, we selected a consecutive cohort of 20 patients (no censored data) who underwent surgical correction of ingrown toenails for study participation. The mean ± SD recovery time was 15.1 ± 2.4 days, and the whole treatment time with the shaped dressing applied ranged from 13 to 20 days. We operated on 26 toes with 38 surgical sites, and neither infection nor hemorrhage was reported.

We compared the distance from the outer edge of the wound to the toenail bed side (Fig. 3A) and the distance from the healed nail fold to the toenail bed side (Fig. 3B) for the four surgical sites, and there was a significant difference in these distances between dressing changes ($P \leq .05$) (Table 1).

A major postoperative complication that can occur after excision of soft tissue is a loss of cutaneous innervations.[12] In the present study, no patients reported any loss of sensation around the operative site. None of the patients reported recurrence at 3, 6, and 12 months after operation.

Discussion

Some studies have demonstrated that the cause of ingrown nails is the change in the growth dynamics of the matrix in the proximal part of periosteum under the skin. The standard practice is partial nail avulsion and matrix ablation, but the preferred treatment is simple nail avulsion alone given the high recurrence rate of approximately 70%.[13] Currently there are a variety of treatment options, such as partial or complete nail avulsions coupled with surgical or chemical (such as phenol) destruction of the nail matrix (matricectomy),[14-16] that aim to remove the partial germinal matrix completely and





Figure 1. continued

prevent recurrence or spicule formation. However, Bos et al[17] reported that even using the method of nail matrix surgical destruction, the recurrence rate was 13.8% after a year. In addition, the chemical reagent may have toxicity,[18] and it is difficult to control the degree of corrosion and to determine whether the matrix has been adequately burned. And the germinal matrix is a deep tissue that









Figure 2. An example of soft-tissue nail fold arc resection combined with a shaped dressing for ingrown toenails. A, An example of surgically corrected ingrown toenails by soft-tissue nail fold excision combined with a shaped dressing after the operation. B, Appearance of the toe on day 1 after the operation. C, Method for changing the shaped dressing. D, On day 8 after the operation, the dressing was changed four times. Surgically corrected ingrown toenails by soft-tissue nail fold excision achieved excellent cosmetic results after the operation.

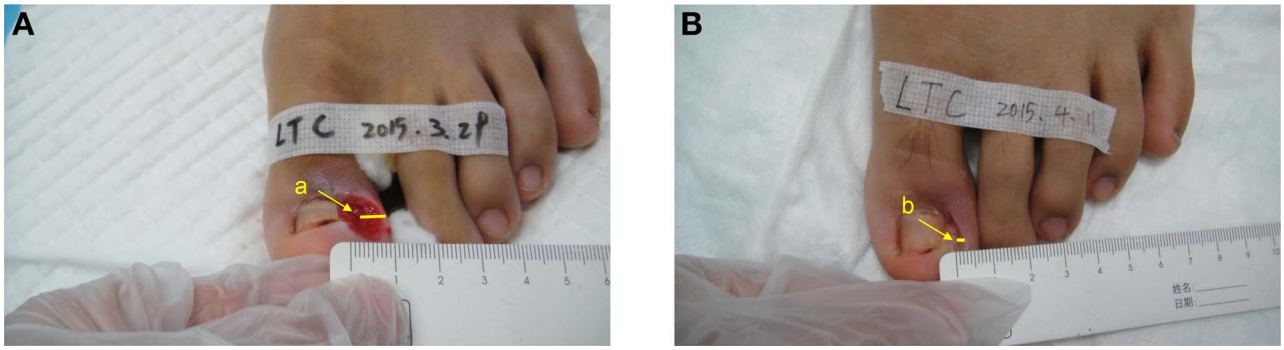


Figure 3. A, Measurement of the distance between the outer edge of the wound and the toenail bed side (the width of the nail fold resection) (arrow a). B, Measurement of the distance between the healed nail fold and the toenail bed side (ie, nail groove) (arrow b).

connects to the periosteum of the phalanges, which was difficult to removed completely by surgical procedure. Furthermore, incomplete damage to the matrix by surgery may lead to matrix deformity and cause mechanical changes for new armor matrix, thus predisposing the patient to recurrence and spicule formation. Yabe and Takahashi[19] reported a method of using an operative microscope to excise partial germinal matrix. Under the operative microscope, the deepest portion of the germinal matrix can be visualized and resected completely, with no recurrence for more than 6 months. However, this method requires a microscope and other instruments, which may restrict its popularization.

Vandenbos and Bowers[4] suggested that increased nail fold skin surrounding the nail contributes to the pathogenesis of ingrown toenails. And Pearson et al[5] reported no differences in the shape of the toenails in patients with ingrown toenails and controls. It is tempting to speculate that the surgical treatment that targets the nail avulsion and matricectomy do not directly address the causative soft-tissue pathology. In recent years, some studies[3,8-12,20] have shown that the lateral nail folds surrounding the nail plate should be removed to decompress the nail and reduce inflammation without matricectomy. These surgical procedures of nail fold soft-tissue resection, which can be implemented in pediatric and adult patients, reported low recurrence rates, good cosmetic results, and high patient satisfaction rates. However, resection of deep soft tissues could impair peripheral nerves and lead to loss of sensation around the operative site.[8,10,20] Postoperative bleeding was another complication.[3] Excessive excision of soft tissue surrounding the nail plate in which sutures were made would lead to persistent pain after the operation that needed analgesics to relieve and obvious scarring after healing.[20] Excessive electrocoagulation in the proximal nail fold close to the nail matrix causing nail deformity,[3] surgical site erythema, swelling, and inflammatory exudates were complications of suture after rescection.[10] To reduce the risk of loss of sensation and postoperative bleeding, we suggested that the nail fold soft tissue should not be excised too deeply. Diabetes or peripheral vascular disease would increase the risk of postoperative bleeding and add to the difficulty of wound healing, so it was best not to perform this operation on these patients. Toes play an important role in strength, providing and keeping balance during walking or running, and assist in stability in some sports due to their flexibility. As an important part of the toe, soft tissue of the nail fold can spread the pressure of the toe during walking or running, and it protects the phalanges from damage. Furthermore, nail fold soft tissue is able to perceive external stimuli, such as pain, heat, and cold. Therefore, the goals when performing the nail fold soft-tissue resection technique should be efficient and easy to manipulate while causing minimal damage, a low recurrence rate, and not affecting patient quality of life. The approach reported in the present study meets all of the previously mentioned criteria. In the procedure, we removed nail fold soft tissue until identifying the subcutaneous fat layer, thus avoiding damage to peripheral nerves and blood vessels, reducing bleeding during the operation and lowering the risk of loss of feeling around the operative site.

Nail growth depends on the nail matrix and nail bed after nail avulsion. If the operative nail fold soft tissue grows tightly from the side of the nail during healing to a narrow nail groove after healing, then the nail will be embedded into the groove again and cause paronychia. The question is how to ensure the expansion of a healed groove without causing excessive damage to nail fold soft tissue, and the

Table 1. Distance Before and After Dressing Change for 38 Surgical Sites in 26 Toes

Surgical Site	Sites (No.)	Width of Nail Fold Resection (cm)	Nail Groove (cm)	Expansion Rate (%)	Distance (Mean ± SD [cm])		*t*	*P* Value
					Before Dressing Change	After Dressing Change		
Left toe								
Lateral side	7	0.4–0.9	0.2–0.7	60.66	0.61 ± 0.18	0.37 ± 0.18	12.021	<.001[a]
Medial side	14	0.3–0.8	0.2–0.5	55.36	0.56 ± 0.16	0.31 ± 0.09	8.832	<.001[a]
Right toe								
Lateral side	11	0.4–0.8	0.2–0.4	60.00	0.55 ± 0.10	0.33 ± 0.78	6.197	<.001[a]
Medial side	6	0.3–0.8	0.2–0.7	67.74	0.62 ± 0.19	0.42 ± 0.17	3.464	.018[a]

[a]Significant difference ($P \leq .05$)

effect of postoperative dressing change on the shape of the nail groove was rarely mentioned.[3,8-12] We used a key technique to make sure that the surgical area was slightly lower than the nail bed and that the postoperative wound was kept flat: a shaped dressing that pressed the wound to ensure smooth wound growth. As a result, there was a significant difference in the distance before compared with after the dressing change for the four sides of the surgical sites, and the shaped dressing effectively prevented the remaining tissue from growing toward the side of the nail. Soft-tissue nail fold arc resection combined with a shaped dressing could expand the groove by more than 50%. At 3-, 6-, and 12-month follow-up visits, all of the 20 patients showed excellent healing, no recurrence, and no postoperative complications.

There were a few limitations in the surgical management combined with a shaped dressing for ingrown toenails. The main limitation of this study is that it was a case series and lacked an internal control group, interobserver analysis, and randomization, which may bias the results. Retrospective analysis was performed in a small number of patients with relatively short follow-up of 9 to 24 months. Therefore, we realize that it is necessary to expand the number of samples for further research. However, in terms of clinical experience, as a new technology, it is simple and easy to manipulate and is worth application.

In summary, we present a novel approach that combines two techniques for the treatment of ingrown toenails: one is excision of nail fold soft tissue while preserving the nail bed and nail matrix, and the other is application of a shaped dressing during the postoperative period. This combined approach can predict no recurrence and no postoperative complications.

Acknowledgments: We thank the patients for choosing our department for surgery and for cooperating with us for dressing change treatment. The wound healer thanks Dr. Henry Chapeskie for his pioneering work. We thank Mr. Jiatao Zang for providing guidance on manuscript drafting and Ms. Xiewan Chen (Medical English Department, Third Military Medical University, ChongQing, China) for critically reading the manuscript and editing the language.

Financial Disclosure: None reported.

Conflict of Interest: None reported.

References

1. Caronia V, Battistioli M, Gualandi O, et al: Treatment of the ingrown toenail by phenol cauterization (ASLUF). Minerva Chir 56: 199, 2001.
2. Nazari S: A simple and practical method in treatment of ingrown nails: splinting by flexible tube. J Eur Acad Dermatol Venereol 20: 1302, 2006.
3. Haricharan RN, Masquijo J, Bettolli M: Nail-fold excision for the treatment of ingrown toenail in children. J Pediatr **162:** 398, 2013.
4. Vandenbos K, Bowers W: Ingrowing toenail: a result of weight bearing on soft tissue. U S Armed Forces Med J **10:** 1168, 1959.
5. Pearson HJ, Bury RN, Wapples J, et al: Ingrowing toenails: is there a nail abnormality? a prospective study. J Bone Joint Surg Br 69: 840, 1987.
6. Fernandez-Flores A, Martínez-Nova A, Salgado-Fernandez S: Ingrown toenail: histopathologic and immunohistochemical study. Am J Dermatopathol **31:** 439, 2009.
7. Martínez-Nova A, Sánchez-Rodríguez R, Alonso-Peña D: A new onychocryptosis classification and treatment plan. JAPMA **97:** 389, 2007.
8. Chapeskie H, Kovac JR: Soft-tissue nail-fold excision: a definitive treatment for ingrown toenails. Can J Surg **53:** 282, 2010.
9. Noël B: Surgical treatment of ingrown toenail without matricectomy. Dermatol Surg **34:** 79, 2008.
10. Zhu X, Shi H, Zhang L, et al: Lateral fold and partial nail bed excision for the treatment of recurrent ingrown toenails. Int J Clin Exp Med **5:** 257, 2012.
11. DeBrule MB: Operative treatment of ingrown toenail by

nail fold resection without matricectomy. JAPMA 105: 295, 2015.
12. Rounding C, Bloomfield S: Surgical treatments for ingrowing toenails. Cochrane Database Syst Rev **11:** 166, 2005.
13. Gupta S, Sahoo B, Kumar B: Treating ingrown toenails by nail splinting with a flexible tube: an Indian experience. J Dermatol **28:** 485, 2001.
14. Heidelbaugh JJ, Lee H: Management of the ingrown toenail. Am Fam Physician **79:** 303, 2009.
15. Peyvandi H, Robati RM, Yegane R-A, et al: Comparison of two surgical methods (Winograd and Sleeve Method) in the treatment of ingrown toenail. Dermatol Surg **37:** 331, 2011.
16. Kruijff S, van Det RJ, van der Meer GT, et al: Partial matrix excision or orthonyxia for ingrowing toe-nails. J Am Coll Surg **206:** 148, 2008.
17. Bos AM, van Tilburg MW, van Sorge AA, et al: Randomized clinical trial of surgical technique and local antibiotics for ingrowing toenail. Br J Surg **94:** 292, 2007.
18. Losa Iglesias ME, Veiga de Cabo J, Tejedor Traspaderne J, et al: Safety of phenol vapor inhalation during performance of chemical matrixectomy to treat ingrown toenails. Dermatol Surg **34:** 1515, 2008.
19. Yabe T, Takahashi M: A minimally invasive surgical approach for ingrown toenails: partial germinal matrix excision using operative microscope. J Plast Reconstr Aesthet Surg **63:** 170, 2010.
20. Noel B: Surgical treatment of ingrown toenail without matricectomy. Dermatol Surg **34:** 79, 2008.