A Simple Therapeutic Approach to Pincer Nail Deformity Using a Memory Alloy: Measurement of Response

Jonathan Te-Peng Tseng, MD,* Wen-Tsao Ho, MD,* Chun-Hung Hsu, MD,* Ming-Hsiu Lin, MD,*† Chien-Nien Li, MD,* and Woan-Ruoh Lee, MD, PhD*†‡

BACKGROUND Pincer nail deformity (PND) is a dystrophy characterized by transverse overcurvature of the nail plate that may cause intractable pain and decrease the quality of life of patients.

OBJECTIVES To evaluated the efficacy of a superelastic nickel–titanium (SE NiTi) wire for the treatment of PND using transverse curvature improvement and subjective assessment of pain relief during and after the treatment.

METHODS SE NiTi wire was implanted over the distal tip of the nail for the treatment of PND in 43 patients (28 female, 15 male), with a total of 73 digits receiving treatment. Evaluations of improvement included measuring changes in transverse curvature of the nail and subjective assessment of pain relief throughout the follow-up period.

RESULTS In all patients, treatment of the pincer nail with implantation of SE NiTi wire achieved satisfactory results. Significant improvement ($p < .05$) of the transverse overcurvature of the nail was seen in all patients at 2 months, and relief of pain was determined in 100% of cases throughout our follow-up period.

CONCLUSION This simple SE NiTi wire insertion method is noninvasive and inexpensive, leaves no cosmetic disfigurement, and leads to excellent therapeutic results. Patients achieved great satisfaction. Thus, this technique should be considered the first line of treatment in the correction of mild to moderate PND.

The authors have indicated no significant interest with commercial supporters.

Pincer nail deformity (PND) is characterized by excessive transverse curvature of the nail plate that increases along the longitudinal axis of the nail. The curvature commonly increases proximally to distally, giving the nail a trumpet-like appearance.[1–5] This results in impingement of the distal nail bed between the free lateral edges of the nail plate, leading to a narrow or even obliterated nail bed. PND may cause excruciating pain and possibly secondary infection, hindering normal walking and markedly decreasing quality of life.[1,2,6] Other names for this condition include incurved nail, unguis constringens, transverse overcurvature, trumpet nail, convoluted nail, and omega nail.[5] PND most frequently affects the large toes but can occur in all toenails and even fingernails. The pathogenesis of PND has not been defined, although numerous factors can contribute to this deformity.[3] PND may arise as a result of mechanical deformation of the nail unit because of exostoses, implantation cysts, or epidermoid cysts.[4,7] Deformity in the foot deviation of phalanges, probably caused by high-heeled or narrow-toed shoes, has also been proposed as a frequent cause of PND.[4,8] PND has been reported in association with infection (tinea unguium), arteriovenous fistula, gastrointestinal malignancies,

*Department of Dermatology, Shuang-Ho Hospital, Taipei Medical University, New Taipei City, Taiwan; †Department of Dermatology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan; ‡Graduate Institute of Medical Sciences, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan

 • Published by Wiley Periodicals, Inc. • ISSN: 1076-0512 • Dermatol Surg 2013;39:398–405 • DOI: 10.1111/dsu.12094

beta-blocker use, and Kawasaki disease.[9–13] In cases associated with the latter two conditions, spontaneous recovery of PND was observed after discontinuation of beta-blockers and recovery from Kawasaki disease. Epidermolysis bullosa simplex (Dowling-Meara type) is also reported to have a possible association with pincer nail abnormality, with a slight thickening of finger- and toenails.[14] Since publication of the first case, a large number of successful conservative and surgical treatment modalities have been described for the correction of PND, but no consensus exists as to the most common and accepted form of treatment. Some surgical therapies have been reported.[1,2,4,6,15–18] Although recurrence is less common after surgical treatment, there are some disadvantages during and after the procedure. These include complexity of the surgery, pain, time consumption, secondary infection, and need for local anesthesia. Moreover, some of the methods may induce cosmetic deformity, resulting in disfigurement. The aim of the study was to demonstrate an excellent conservative treatment modality for pincer nail. This study evaluated the efficacy of a superelastic nickel–titanium (SE NiTi) wire, originally designed for orthodontic practice, in the treatment of PND by measuring transverse curvature improvement and subjective assessment of pain relief during and after treatment. SE NiTi wire is composed of shape-memory NiTi alloy and has strong elasticity. Machida and colleagues first introduced the material and methodology in the treatment of ingrown and curved nails in 1999, with promising results.[19] Thereafter, Moriue and colleagues[20] applied a similar therapeutic strategy for treating ingrown nails with successful outcomes. This research presents a case series study describing the clinical benefits of SE NiTi wire for the treatment of pincer nails.

Methods

This case series study was performed on patients with PND who received SE NiTi wire treatment. We assessed the therapeutic effects of this modality in monthly follow-up visits measuring transverse curvature of the nail and improvement in quality of life, such as relief of pain and discomfort. This study was performed in the Department of Dermatology at Taipei Medical University, Shuang-Ho Hospital. The trial was conducted according to the ethical guidelines of the Declaration of Helsinki. The Ethical Committee of the university reviewed the protocol and granted approval for the study.

Patients

This technique was used to treat 43 patients with symptomatic PND, with a total of 73 affected digits. All patients (28 female, 15 male, mean age 43, range 20–101) complained of pain while wearing closed-toe shoes or even at the slightest touch. Each patient provided written informed consent.

Patients with severe deformity of the nail bed, concurrent ingrown nail with infection, and concurrent granulation tissue around the periungual region were not treated. Preoperative evaluation included presence of onychomycosis, history of ingrown nail, prior trauma to the affected digits, prior treatment of the nail, and family history of similar deformity. Patients were instructed to return monthly to take the clinical outcome assessment.

Intervention

The wire used was the SE NiTi wire (Highland Metals Inc., San Jose, CA), which was originally designed for the orthodontic practice of teeth straightening. The wire is available in several different diameters (0.12–0.20 inches), with an oval-shaped cut surface. This study primarily used 0.16- and 0.18-inch wires for treatment.

The technique was based on the description provided by Moriue and colleagues[20] and Machida and colleages,[19,21] with minor modification. The SE NiTi wire method is indicated for clinically diagnosed PND when the width of the free border of the affected nail is greater than 2 mm and the angle of the nail plate is within 90°.[20]

Two holes are made using 18-G needles at the distal free edge of the nail plate in the white portion, which does not have sensation (Figure 1A and B). When drilling, the needle should be held obliquely so that the wire can be easily bent and inserted into another hole from the outside of the nail (full insertion of the needle is unnecessary). Care should be taken not to puncture soft tissue.

The wire is then pushed with pliers downward into one of the holes (Figure 1C), and the other end of the wire is bent forward and inserted into another hole (Figure 1D and E). Finally, the excess wire is cut with clippers to prevent it from protruding from the nail end.

Medical adhesive tape (elastic adhesive tape, 3M Company, Maplewood, MN) is cut into small pieces and attached to the wire implantation site. This final step protects the nail plate and prevents the wire from detaching (Figure 1F).

A cotton cap may be added to the end of the SE NiTi wire below the nail plate to protect the nail bed from wire-induced injury. Patients should avoid strenuous exercise, which may damage the nail plate. The procedure takes 10 to 15 min, and the wire typically remains in place for 2 to 3 months. After treatment, the nail plate becomes sufficiently flat, and the wire can be pulled out with pliers.[20]

Clinical Assessment

Improvement of the transverse curvature of the nail was evaluated based on the following two systems:

For statistical comparison, nail height (A) and nail width (B) at the distal end of the nail were measured directly using a caliper, and the ratio of A to B was calculated (Figure 2). As the ratio approaches 0, it indicates a flatter nail plate, whereas higher values are indicative of a nail displaying marked dorsal protrusion.

The patients provided subjective data. They were asked to rate pain relief along a scale with three options: no relief, partial relief, and total relief.

(Clinical photographs of the nail were also taken to assist in the evaluation).

Statistical Analysis

SPSS 13.0 (SPSS, Inc., Chicago, IL) was used to perform statistical analysis. A two-sample *t*-test was used to determine the correlation of the severity of transverse overcurvature of the nail in PND patients with the presence of onychomycosis or a history of ingrown nail at the baseline. A paired *t*-test was also performed to compare transverse overcurvature of the nail before and after treatment. $p < .05$ was considered statistically significant.

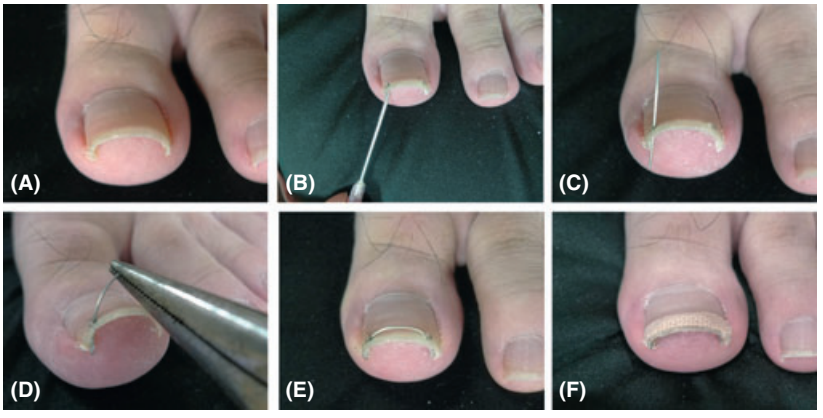

Figure 1. (A) Pincer nail deformity. (B) Holes are made using needles. (C–E) The wire is inserted into the holes. (F) Medical adhesive tape is attached to the wire implantation site.

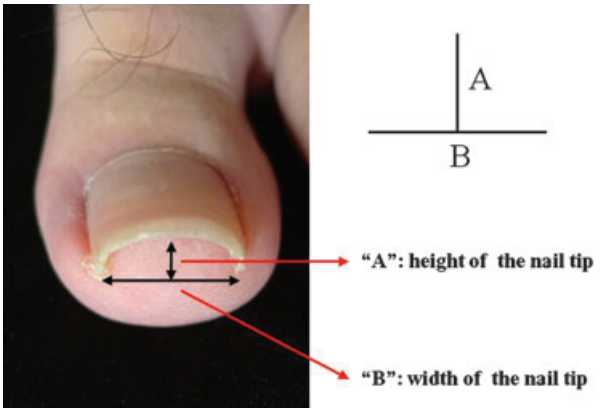

Figure 2. Pincer nail deformity. Nail height (A) and nail width (B) at the distal end of the nail were measured. The ratio of A to B was calculated.

TABLE 1. Baseline Demographic Data and Disease Characteristics of All Patients with Pincer Nail Deformity

Characteristic	*Value*
Patients (digits), *n*	43 (73)
Age, mean (range)	43 (20–101)
Sex, patient; digit, *n* (%)	
Male	15 (35); 26 (36)
Female	28 (65); 47 (64)
Duration of disease, years, range	0.4–20
Onychomycosis, patient; digit, n (%)	
Yes	34 (79); 52 (71)
No	9 (21); 21 (29)
Medical history of ingrown nail, patient; digit, *n* (%)	
Yes	23 (53); 39 (53)
No	20 (47); 34 (47)

Results

The demographic and clinical characteristics of all patients at baseline are presented in Table 1. Three patients had the hereditary type of PND in that they had a positive family history revealing the same deformity in parents or siblings. Twenty-five patients had bilateral toenail involvement. In three patients, several lesser toes were also involved to varying extents. Although PND patients with onychomycosis outnumbered those without onychomycosis, no significant difference in the severity of PND at baseline was detected between the two groups. A statistically significant difference in the severity of PND at baseline was detected between PND patients with and without a medical history of ingrown nail. The degree of transverse overcurvature seen in PND patients with a medical history of ingrown nail was more severe than in those without.

The transverse curvature of the nail was measured in all 43 patients with clinically confirmed PND for at least 2 consecutive months. The improvement in quality of life regarding relief of pain and discomfort was evaluated continuously according to clinical follow-up or telephone interview for at least 6 months. Difficulties in coming to the outpatient clinic and other personal reasons caused discrepancies in the length of the outpatient clinic follow-up periods.

In all patients, treatment of the pincer nail achieved satisfactory results, and all clinical symptoms were relieved during or after therapy. Photographs demonstrating the treatment response of some PND patients are shown in Figure 3. The SE NiTi wire implantation method was found to be well tolerated and safe. None of the enrolled patients reported any adverse events from the treatment. No ingrown nail or infection occurred during the treatment period. The progress of nail flattening over a 2-month period is shown in Figure 4. All patients showed significant therapeutic response to the SE NiTi wire. In two with thick nail plates, minimal response of the PND was observed at the 1-month mark, so a second wire was implanted. Flattening of the nails was seen at their next visits (Figure 5).

Total relief of pain was achieved in all 43 patients by the third month. In some patients, immediate relief of pain was observed right after implantation of the wire. The average recurrence rate of this method remains under investigation, but of the three patients with hereditary PND, two experienced recurrence by the sixth month. Patients with recurring PND preferred having the wire reinserted because of the immediate satisfactory outcome that the procedure offered, along with the lack of associated discomfort during and after therapy.

Figure 3. Pincer nail deformity. Photographs demonstrating the treatment response of some patients with pincer nail deformity. (A) Pretreatment condition. (B) Post-treatment condition at 2 months. The curvature of the nail plate has been improved.

Discussion

Pincer nail deformity is a nail pathology that develops with accompanying pain and discomfort, affecting quality of life. It is characterized by an increase of transverse curvature along the longitudinal axis of the nail.[2,3] Despite several causative factors having been identified, the pathogenesis of PND remains unclear. Controversy exists as to whether osteophytes are a cause or a result of nail deformity. A recent investigation[5] supported the latter hypothesis. First, the nail begins to incurve

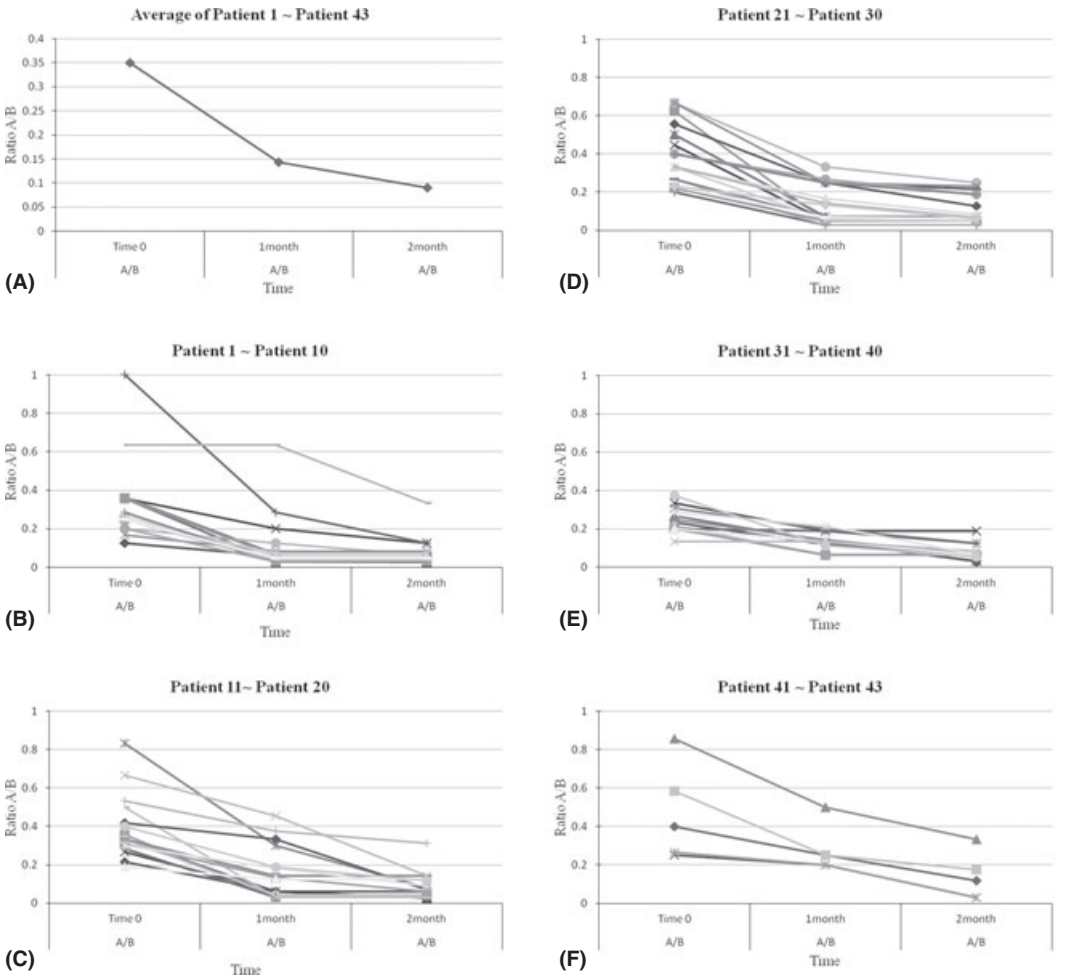

Figure 4. Transverse curvature of the pincer nail deformity: The ratio of A to B at 0, 1, and 2 months were compared. As the ratio approaches 0, it indicates a flatter nail plate, whereas higher values are indicative of a nail with marked dorsal protrusion. (A) Demonstrating the average of the A to B ratio of all 43 patients (73 digits) at different time marks. (B–F) Results of every patient (in digits).

because of an underlying pathogenesis. Then, as the distal end of the nail becomes elevated, continuous traction is subsequently exerted on the distal dorsal tuft. This phenomenon can be considered a secondary deformity consequent to the primary nail deformity. Thus, an osteophyte of the distal phalanx may be the result of an overcurving deformity, rather than a cause.[5] Essentially, the etiology of PND can be divided into hereditary and acquired forms. Hereditary PND is almost always symmetrical, and similar nail changes may be seen in other family members. Acquired PND is not symmetrical, although in some cases, involvement may be extensive and appear to be fairly symmetrical.[4] Treating PND has always been challenging, whether managed surgically or conservatively. No common and widely accepted classical method has been presented in the literature, although different therapeutic strategies have been proposed. Dermatologists in Taiwan commonly perform total or partial excision of the nail bed and phenol matricectomy, but these methods may leave disfigurement and are considered overly aggressive for mild to moderate PND. In our opinion, surgical interventions are more suitable in cases involving severe deformity of the nail or in patients who have received unsuccessful conservative treatments previously.

Figure 5. (A) view from anterior aspect. (B) view from dorsum aspect. Pincer nail deformity. Pincer nail deformity patient with thick nail plates (0 months). Minimal response was observed at the 1-month mark, so a second wire was implanted. One month after implantation of two wires the curvature of the nail plate had improved (2 months). One wire was later removed as the nail grew longer (4 months).

Patients are commonly encouraged to undergo thinning of the nail plate as a conservative treatment. Although some benefit may be seen, this procedure seemingly has low patient adherence and a long treatment period, and in cases of severe deformity, it does not produce satisfactory results easily.

This study used a shape-memory alloy therapeutic procedure that has numerous advantages over other methods. The alloy used was an SE NiTi wire, originally designed for orthodontic practice. This alloy has two unique properties. One is its shape-memory effect, and the other is its outstanding elasticity" The elasticity of the wire helps returning the overcurvature of the PND to its original state. Even if the wire is bent, the shape-memory effect is sustained for several months. Comparable with previous research using similar material,[19,21] these results show that treatment with SE NiTi wire is effective at relieving pain and discomfort. Most patients confirm cosmetic improvement. Patients with slight curvature of the toenail achieve relief from pain immediately after treatment. Machida recommends using an adhesive to attach the wire to the nail plate tightly.[20] In this study, we used medical adhesive tape, which not only prevents detachment of the wire, but also protects the nail plate.

According to this study, no major risk is associated with this therapeutic strategy, with the exception that extra care should be taken not to puncture soft tissue during the implantation process. The risk of contact allergy from the SE NiTi wire is believed to be low because the wire used was originally designed for the orthodontic practice of teeth straightening.

Other than the excellent therapeutic results shown in this study, this strategy has several other advantages. It is particularly useful for patients who cannot miss work and those with diabetes, peripheral vascular disease, or any disease that might affect wound healing.[20] This method can be performed easily in an outpatient clinic with only 10 to 15 min of therapeutic time, and local anesthesia is not required during the process. Moreover, the cost of the wire is low, and the wire is easy to acquire.

In some patients with thick nail plates, insertion of two wires simultaneously or repeated treatment may be indicated. A high prevalence of onychomycosis was observed in the patients in this study. Although no statistically significant difference was detected between patients with and without onychomycosis in severity of PND at baseline, severity of onychomycosis may be a determining factor for therapeutic response because of the thickness or fragility of the nail plate. According to the research data, the degree of transverse overcurvature seen in patients with PND with a medical history of ingrown nail is more

severe than in those without. That is, ingrown nail may play an important role in the pathogenesis of PND. Further studies may be required to determine the above hypotheses.

Many patients seen in the clinic had multiple toes with nails cut too short for the procedure to be performed immediately. Patients should be instructed on proper nail cutting and footwear. In a nail with improper cutting, the cut lateral nail edge often regrows in a notched manner over the nail bed, creating spicules and serrated nail edges. These irregular nail edges pierce the surrounding soft tissue and cause pain, inflammation, and granulation tissue, which ill-fitting footwear further compounds.[22] Therefore, patient education plays an important role in successful treatment.

The average elapsed time between SE NiTi wire removal and recurrence of PND was not measured because it was not the objective of the current study, but this could be an interesting parameter to help increase understanding of the pathogenesis of PND and the characteristics of the SE NiTi wire. Further study may be warranted.

Conclusion

This clinical study presented a simple strategy to treat PND using SE NiTi wire. This technique has several distinct advantages over other methods. It is noninvasive, inexpensive, and easy to perform; leaves no cosmetic disfigurement; and has excellent therapeutic results. Patients achieved great satisfaction. It is particularly useful for patients with diabetes, peripheral vascular disease, or any disease that might affect wound healing. This method is currently our first choice of treatment for mild to moderate PND. Surgery was indicated only in severe cases or in cases in which use of SE NiTi wire failed.

References

1. Mutaf M, Sunay M, Isk D. A new surgical technique for the correction of pincer nail deformity. Ann Plast Surg 2007;58:496–500.
2. Aksakal AB, Akar A, Erbil H, Onder M. A new surgical therapeutic approach to pincer nail deformity. Dermatol Surg 2001;27:55–57.
3. Kim KD, Sim WY. Surgical pearl: nail plate separation and splint fixation—a new noninvasive treatment for pincer nails. J Am Acad Dermatol 2003;48:791–792.
4. Baran R, Haneke E, Richert B. Pincer nails: definition and surgical treatment. Dermatol Surg 2001;27:261–266.
5. Kosaka M, Kusuhara H, Mochizuki Y, Mori H, et al. Morphologic study of normal, ingrown, and pincer nails. Dermatol Surg 2010;36:31–38.
6. Plusje LG. Pincer nails: a new surgical treatment. Dermatol Surg 2001;27:41–43.
7. Baran R, Broutart JC. Epidermoid cyst of the thumb presenting as pincer nail. J Am Acad Dermatol 1988;19:143–144.
8. Baran R, Dawber RPR, Tosti A, Haneke E. A text atlas of nail disorders. London: Martin Dunitz; 1996.
9. Higashi N. Pincer nail due to tinea unguium. Hifu 1990;32:40–44.
10. Hwang SM, Lee SH, Ahn SK. Pincer nail deformity and pseudo-Kaposi's sarcoma: complications of an artificial arteriovenous fistula for haemodialysis. Br J Dermatol 1999;141:1129–1132.
11. Jemec GB, Thomsen K. Pincer nails and alopecia as markers of gastrointestinal malignancy. J Dermatol 1997;24:479–481.
12. Greiner D, Schofer H, Milbradt R. Reversible transverse overcurvature of the nails (pincer nails) after treatment with a β-blocker. J Am Acad Dermatol 1998;39:486–487.
13. Vanderhooft SL, Vanderhooft JE. Pincer nail deformity after Kawasaki's disease. J Am Acad Dermatol 1999;41:341–342.
14. Kitajima Y, Jokura Y, Yaoita H. Epidermolysis bullosa simplex, Dowling-Meara type. A report of two cases with different types of tonofilament clumping. Br J Dermatol 1993;128:79–85.
15. Ozawa T, Yabe T, Ohashi N, Harada T, et al. A splint for pincer nail surgery: a convenient splinting device made of an aspiration tube. Dermatol Surg 2005;31:94–98.
16. Kosaka M, Kamiishi H. New strategy for the treatment and assessment of pincer nail. Plast Reconstr Surg 2003;111: 2014–2019.
17. Brown RE, Zook EG, Williams J. Correction of pincer-nail deformity using dermal grafting. Plast Reconstr Surg 2000;105:1658–1661.
18. Hatoko M, Iioka H, Tanaka A, Kuwahara M, et al. Hard-palate mucosal graft in the management of severe pincer-nail deformity. Plast Reconstr Surg 2003;112:835–839.
19. Machida E, Maruyama K, Sano S. The correction of ingrown, curved nails with super elastic wire. J Jpn Soc Surg Foot 1999;20:S87.
20. Moriue T, Yoneda K, Moriue J, Matsuoka Y, et al. A simple therapeutic strategy with super elastic wire for ingrown toenails. Dermatol Surg 2008;34:1729–1732.
21. Machida E. Treatment of pincer nail using Machiwire and Machiplate. MB Derma 2007;128:42–48.
22. Arai H, Arai T, Nakajima H, Haneke E. Formable acrylic treatment for ingrowing nail with gutter splint and sculptured nail. Int J Dermatol 2004;43:759–765.

Address correspondence and reprint requests to: Woan-Ruoh Lee, MD, PhD, 291 Jhongjheng Rd., Jhonghe District, New Taipei City, 23561, Taiwan (R.O.C.), or e-mail: wrlee@tmu.edu.tw