Thin Split-Thickness Toenail Bed Grafts for Avulsed Nail Bed Defects

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Abstract: Avulsed defect of a fingernail bed is a common injury in acute hand trauma. Insufficient management for this type of nail bed avulsion often leads to an irregular and nonadherent nail. The use of thin split-thickness sterile matrix graft from the great toe for immediate replacement of a nail bed defect can regain a smooth, adherent, and normal-looking nail. Between May of 1998 and December of 2001, we used thin split-thickness toenail bed grafts in 13 fingers of 12 patients with avulsed defects of the nail bed. The end results of this technique were excellent and no deformities occurred in the graft donor area. Thin split-thickness toenail bed graft is a good choice for the treatment of acute nail bed avulsion.

Key Words: nail bed graft, nail bed injury

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The fingertip is the most commonly injured part of the hand, and its injury frequently results in avulsion of a segment of the nail bed. Restoration of a flat and smooth nail bed is essential for regrowth of a normal nail, which is important not only for cosmetic reasons but also for tactile capability of the fingertip. When the avulsed nail bed segment is available for immediate replacement, a smooth nail bed can be obtained and a normal nail can grow.[1,2] But when the avulsed segment is severely crushed or lost and the defect is allowed to heal by granulation, a significant scar will occur and produce an irregular, thickened, and nonadherent nail (Fig. 1). Different methods for the repair of avulsed nail bed defects have been reported. Although the use of a full-thickness nail bed graft can result in a normal-appearing nail, the donor digit or toe will be left with a nail deformity.[3] The use of split-thickness skin graft is able to avoid donor-site morbidity, but nonadherence of the growing nail to the skin graft is the common deformity.[4] The use of free vascularized toenail bed graft can get a reliable nail growth,[5] but the microvascular transfer is technically demanding and results in scars on the foot, toe, and finger. Based on the concept of using like tissue to resurface the defect, thin split-thickness toenail bed graft is a good choice for the treatment of injury involving loss of full-thickness nail bed tissue. There is usually no donor-site morbidity of the great toe. We used the thin split-thickness toenail bed grafts to treat 12 patients, and the experience obtained from the management of these cases formed the basis of this report.

PATIENTS AND METHODS

We used split-thickness toenail bed grafts to treat 12 patients who suffered avulsed nail bed defects in 13 fingers between May of 1998 and December of 2001. The patients included 11 men and 1 woman, ranging in age from 20 to 43 years.

Operative Technique

With the aid of tourniquet control, the operation is performed with the patient under local or general anesthesia. Debridement of nonviable tissue of the nail bed should be conservative, and the depth and size of the defect are evaluated. If the avulsion is partial thickness, grafting is not necessary because the regeneration of a functional nail bed will occur without the aid of graft.[6] If the nail bed defect is not appropriate for primary closure or there is more tension on the nail bed with a closure, a prominent scar will occur without the aid of graft. A loupe or microscope is used to facilitate taking a thin graft. Following removal of the nail plate of the great toe, a thin graft is harvested with a No. 10 scalpel from the midportion of the sterile matrix which is the thickest part of the toenail bed. An attempt is made to keep the graft thin enough to be transparent. The cutting edge of the scalpel is continually seen. If the operator loses visibility of the tip of the scalpel, the graft is being taken too deep and a more superficial level should be sought. The thickness of the

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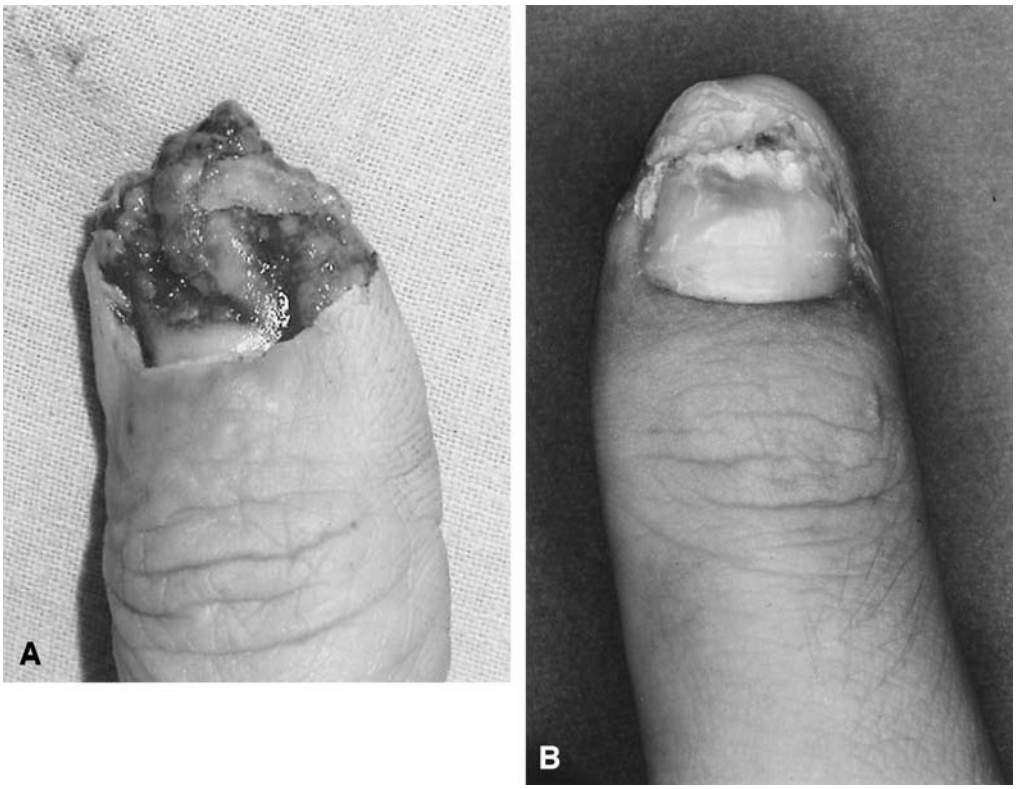

FIGURE 1. A, A 50-year-old woman sustained a crushing injury to the fingertip of the right thumb with avulsed nail bed defect. B, When the nail bed defect was allowed to heal by granulation, a significant scar occurred and produced an irregular, thickened, and less than full adherent nail.

graft harvested using this technique typically varies from 7 to 10 thousandths of an inch and the graft should be 1 to 2 mm larger than the defect.[3] After the thin graft is paved on the recipient nail bed and sutured in place with 7–0 chromic catgut, it is a standard practice to use the avulsed fingernail or a plastic nail as a temporary splint to keep the proximal nail fold open, to immobilize the nail bed graft, and to reduce postoperative discomfort.

RESULTS

All 13 fingers regained smooth, adherent, and normal-looking nails. The contracture of split-thickness nail bed graft was considerably less than that which occurs with conventional split-thickness skin graft. There were no donor-site deformities in this series.

CASE REPORTS

Case 1

A 33-year-old man sustained a crushing injury to the right hand, which resulted in avulsed nail bed defect of the middle finger and traumatic amputation of the ring and little fingers. The ulnar half of the nail bed was lost, and there was a full-thickness defect. A thin split-thickness nail bed graft harvested from the right great toe was used to restore the defect. Two weeks after the procedure, following removal of the protective plastic nail, the nail bed had a flat and smooth surface, and it was hard to differentiate the toenail bed graft from the fingernail bed. At the 10-month follow-up examination, the nail of the middle finger had regained its normal appearance (Fig. 2).

Case 2

A 23-year-old woman presented with a crushing injury with avulsed nail bed defects of her right index and middle fingers. Each finger had lost nearly 80% of the nail bed. One split-thickness nail bed graft was taken from each of the great toes to restore the nail bed defects. At 14-month follow-up examination, the nails of both the recipient fingers and donor toes were smooth and normal-looking (Fig. 3).

DISCUSSION

The fingernail is a sophisticated skin appendage important to both the appearance and function of the finger. The nail provides counter-pressure over the volar skin and pulp, allowing the performance of skilled hand functions requiring precise touch and the ability to pick up small objects. Consequently, a rough and irregular fingernail can be a functional as well as a cosmetic problem.[7]

FIGURE 2. A, Avulsed nail bed defect of the middle finger and traumatic amputation of the ring and little fingers. B, The ulnar half of the nail bed was lost and there was a full-thickness defect (arrows). A thin split-thickness toenail bed graft (arrowheads) was harvested to restore the defect. C, Two weeks later, following removal of the protective plastic nail, it was hard to differentiate the toenail bed graft from the fingernail bed. D, At the 10-month follow-up examination, the middle finger revealed a normal-looking nail.

The mature nail is composed of 3 layers, each originating from a different area. The dorsal nail fold contributes to the shine of the nail and the flat distal growth. The germinal matrix of the nail bed produces the majority of the nail volume. The sterile matrix of the nail bed is a highly specialized tissue involved in shaping and adhering of the advancing nail.[8]

Avulsion of a segment of the nail bed is common in major fingertip injury. Avulsions of the sterile matrix occur

FIGURE 3. A, Avulsed nail bed defects of the index and middle fingers. B, One split-thickness toenail bed graft was harvested from each of the great toes. C, Each finger had lost nearly 80% of the nail bed and the grafts (arrows) were used to resurface the defects. D, Two weeks after the procedure, the nail beds had regained their flat and smooth surface. E, At the 14-month follow-up examination, the index and middle fingers had normal-appearing nails with slightly decreased distal nail bed volume. F, Neither of the donor great toes showed deformity.

with greater frequency than those of the germinal matrix. This is due to the greater susceptibility to injury of the more distally located structures and the protection afforded the germinal matrix by the proximal nail fold.[3] If the nail bed avulsion is allowed to heal by scarring, the new nail will be rough, thick, and nonadherent, attaching only to those areas of the germinal matrix and residual smooth sterile matrix. Because the incidence of deformity after injuries to the nail bed is high and the results of late secondary repair of nail deformities are poor, it is important to properly diagnose and treat these injuries soon after their occurrence. As the rewards of meticulous primary repair are so great, every effort should be made to primarily repair the various types of nail bed avulsion.

In patients with absence of the avulsed nail bed segment, the success of nail bed replacement is inconsistent when tissues other than those of the nail bed are used. The sterile matrix of the nail bed represents a highly specialized tissue performing the very particular function of shaping and adhering to the advancing nail plate. "Like tissue" appears to be the only satisfactory replacement for this complex tissue. Full-thickness toenail grafts serve quite nicely as replacement. The disadvantage of this procedure is the deformity of the donor area. Obviously, the ideal reconstruction of any defect should lead to excellent morphologic and functional results while keeping donor site morbidity at a minimum. The use of thin split-thickness nail bed grafts taken from the toenail has been shown to produce consistently successful results. The procedure allows access to abundant nail bed tissue in the great toe without producing deformities at the donor site.

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