

Minimizing Impairment in Laborers with Finger Losses Distal to the Proximal Interphalangeal Joint by Second Toe Transfer

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Traditionally, toe-to-hand transfers have been reserved for thumb amputations or for use after severe mutilating injuries. The authors report their experience with the use of second toe-for-finger amputations with preserved or reconstructible proximal interphalangeal joints in manual workers. The aim of the procedure was to reduce impairment and to upgrade the hand from a functional and cosmetic standpoint. Fifteen second-toe wrap-around or variations were carried out on 11 adults (18 to 41 years old). Four patients with two or more finger amputations received two sequential second toes; four patients with two finger amputations received one toe; and each of three patients with single-digit amputation received a single toe. All but one amputation were performed less than 3 weeks after the accident. All toes survived. Range of motion at the native proximal interphalangeal joint was more than 90 percent in all patients but one; however, it was minimal at the transplanted joints. Patient satisfaction was high from a cosmetic and functional standpoint. Ten of 11 laborers resumed their previous activity. On the basis of this experience, a classification with aesthetic and functional implications is proposed to help in the decision-making process when dealing with multidigital injuries. It is concluded that second-toe transfer is an excellent choice for finger amputation distal to the proximal interphalangeal joint in laborers. Its prime indication is for amputations of two fingers where at least one toe should be transferred, as required, to achieve an "acceptable hand" (three-fingered hand). Early transfer allows salvage of critical structures from the damaged finger, such as joints, tendons, and bone, that otherwise would be lost. Early transplantation is highly recommended. (*Plast. Reconstr. Surg.* 112: 1000, 2003.)

Toe-to-hand transfer has traditionally been reserved for thumb reconstruction or for use

after severe injuries, as in the metacarpal hand.¹⁻⁴ As the safety of the procedure has improved, the indications have been extended to less severe injuries, congenital and acquired, that only affect fingers.⁵⁻¹²

Reconstruction of finger amputations distal to the proximal interphalangeal joint in laborers has not received much attention in the literature. This is surprising because finger losses distal to the proximal interphalangeal joint are, in our experience, an important source of disability and early retirement of capable workers. These minor injuries entail a high burden to society and to the patients' image and self-esteem.¹³

The good results obtained in the finger replanted distal to the flexor superficialis insertion¹⁴ pushed us to indicate toe transfer in cases of distal finger amputations in which replantation was not feasible or had failed.

The purpose of this article is to present our experience in distal finger reconstruction with preserved or reconstructible proximal interphalangeal joints with second-toe transfer. In contrast to previous articles in which the indications were mainly for children, for cosmesis in women, or for very specific professions (e.g., musicians), in this study all patients were involved in manual work, and most (10 out of 11) sustained the injury at work and were covered by workers' compensation. The aim of the re-

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construction was to reduce disability and to allow the return to previous labor. Cosmesis was a secondary goal, but obviously not disregarded, as it has an effect on well-being and self-esteem.

PATIENTS AND METHODS

From February of 1995 to January of 2002, we performed 45 toe-to-hand transfers with a 97 percent survival rate, which represents all our experience with no exclusion. Fifteen second toes were transferred to reconstruct fingers amputated distal to the proximal interphalangeal joint in 11 patients (18 to 41 years old). They form the basis of this study (Table I). Most patients were men involved in heavy labor, including three carpenters, four construction workers, and one mechanic. Two women had one toe transfer each; one was working with heavy machinery and the other was an assistant in a bakery factory. All but patient 9, a student electrician at the time of the accident, sustained the injury while working and were covered by workers' compensation. All but patient 2 had the operation in the acute or subacute stage less than 3 weeks after the accident with the stumps still open. To help in the decision-making process, a classification of multidigital injuries is proposed which recognizes four possible situations and end results: normal hand, acceptable hand, unbalanced hand, and crippled hand (Fig. 1). A near-normal hand has four fingers with near-normal length

and sensation and a normal thumb. An acceptable hand should have, apart from a thumb, at least three fingers, with normal motion at the proximal interphalangeal joint, with at least protective sensation, and as much length as possible distal to the proximal interphalangeal joint, but more importantly, it should be harmonious in length. The proportioned length of the fingers should not be disregarded, as even minimal shortening in one finger draws attention to the others and gives a mutilated aspect (unbalanced hand). A hand with only two functioning fingers is limited from a cosmetic and functional standpoint (crippled hand). With this scheme in mind, we then decided what to do. The aim was to convert a crippled or unbalanced hand into an acceptable or normal one.

Patients 1 to 8 had two or more fingers amputated: Four patients (patients 1 to 4) had two sequential toe transfers, separated by a week, and the other four patients (patients 5 to 8) had just one finger reconstructed. The decision to reconstruct just one out of two fingers in the latter group was taken in a case each because of proximal amputation that was treated by ray resection (case 5), amputation proximal to the proximal interphalangeal joint (case 6), consideration by the patient that he had improved enough with just one transfer (case 7), and consideration that the gain did not deserve the effort (case 8). In three pa-

TABLE I
Demographics and Surgical Details

Patient	Case	Age (yr)	Occupation	Affected Finger/ Dominance*	Reconstructed Finger†	Delay‡ (mo)	Donor Artery	Recipient Artery (type)§	Recipient Vein (type)§
1	1A	18	Carpenter	2-5/ND	3 (F2)	15	FPMA	Digital (E-E)	Dorsal (E-S)
	4 (F2)				24	FPMA	Digital (E-E)	Dorsal (E-S)	
2	2A	41	Carpenter	2-5/D	4 (F2)	241	FPMA	Commissural (E-E)	Dorsal (E-S)
	5 (F2)				248	FPMA	Digital (E-E)	Dorsal (E-S)	
3	3A	24	Construction worker	2-4/D	4 (F3)	3	FDMA	Digital (E-E)	Dorsal (E-E)
	3 (F2)				12	FPMA	Digital (E-E)	Dorsal (E-E)	
4	4A	40	Carpenter	2-5/D	3 (F2)	2	FDMA	Commissural (E-S)	Dorsal (E-S)
	2 (F2)				9	FDMA	Digital (E-E)	Dorsal (E-S)	
5	5	27	Baker	2 and 3/D	2 (F2)	5	Dorsalis pedis	Radial (E-S)	Dorsal (E-S)
6	6	38	Construction worker	2, 4, and 5/D	2 (F2)	1	FDMA	Commissural (E-E)	Dorsal (E-S)
7	7	20	Construction worker	4 and 5/D	4 (F2)	3	FDMA	Digital (E-E)	Dorsal (E-E)
8	8	26	Machinist	2-5/ND	4 (F2)	1	Digital (×2)	Digital (×2) (E-E)	Dorsal (E-E)
9	9	18	Electrician	2/D	2 (F3)	2	FDMA	Commissural (E-S)	Dorsal (E-S)
10	10	32	Construction worker	1-3/D	3 (F2)	5	FDMA	Commissural (E-S)	Dorsal (E-S)
11	11	29	Mechanic	2/D	2 (F3)	3	FDMA	Digital (E-E)	Dorsal (E-E)

ND, nondominant; D, dominant; FPMA, first plantar metatarsal artery; FDMA, first dorsal metatarsal artery; E-E, end-to-end anastomosis; E-S, end-to-side anastomosis.

* Digits injured.

† Refers to where the toe was transplanted, with level of amputation in brackets.

‡ Time to reconstruction.

§ Type of anastomosis.

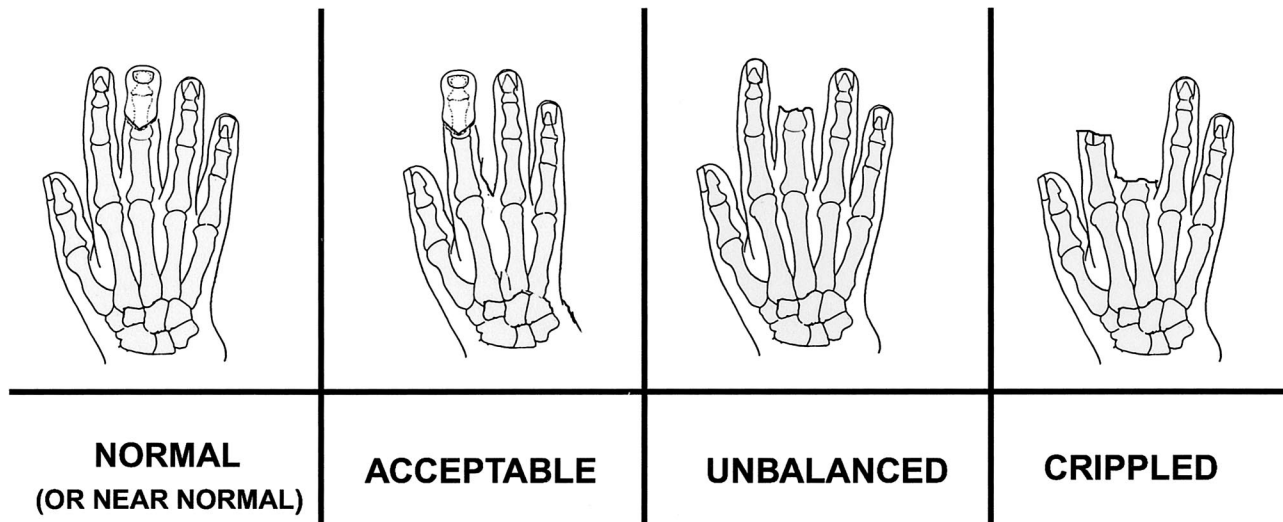


FIG. 1. Authors' classification of multidigital injuries using the preoperative and postoperative status of patients 5 and 10.

tients, a single finger was transferred for a single loss (Fig. 2).

Preoperative radiographs of the damaged and normal hands and of the donor foot were taken. The arterial anatomy of the foot was assessed by a pencil Doppler probe as suggested by Banis.¹⁵ No preoperative angiograms were done.¹⁶ Toes were harvested in custom-made fashion as suggested by Foucher et al.⁵ and Wei et al.⁸ The technique of toe transfer has been widely published in the literature, but some details are discussed later.

At the latest follow-up visit (minimum 6 months), the range of motion at native and transplanted proximal interphalangeal and distal interphalangeal joints was measured, and the grip and sensibility were tested. Using a visual analogue scale, patients subjectively assessed the aesthetic and functional result from 0 to 10. They also were asked if they would repeat and/or recommend the operation to others.

RESULTS

Eight patients with crippled hands were upgraded, two to normal hand (Figs. 3 and 4) and six to an acceptable hand (Figs. 5 and 6). Three patients with unbalanced hands moved to normal hand status. Other data are summarized in Table II.

Survival and Complications

The survival rate was 100 percent. Patient 9 was taken back to the operating room 6 hours after the initial operation due to signs of arterial insufficiency. After removal of all dressing,

and before anesthesia, a skin stitch was noted to strangulate the pedicle at its entrance; its removal reestablished flow. Patient 6 felt a "pop" 6 weeks postoperatively during rehabilitation. This was judged to be related to tenorrhaphy rupture between the flexor digitorum profundus and flexor digitorum longus. As the distal interphalangeal joint continued to be stable with no hyperextension, no surgical treatment was considered.

Additional procedures were required. Patient 2 underwent tenolysis 6 months after the transplants. Patients 1 and 5, who were scheduled for wire removal under local anesthesia, had at the same time some skin flap adaptation to improve a moderate "cobra deformity."¹⁷ Patient 4 required an arthrodesis on the distal interphalangeal joint of the small finger unrelated to the transplants.

Patient 2 complained of gait disturbances while walking barefoot on one of the feet, which slowly disappeared over a 6-month period. To reduce the cosmetic impact in the foot in three patients, part of the second toe was preserved. In patient 10, the skin necrosed, and the toe was resected at the metatarsal head level.

Functional Results

Using a visual analogue scale, patients gave utility in daily activities, including work, a rating of 9.1 (range, 6.5 to 10; 0 = nil, 10 = normal) (Table II). Ten out of 11 patients returned to their previous activity and normal duties without limitations at an average time of 4.5 months (range, 2.5 to 8 months). Patient 2 returned to work as a carpenter 10 months

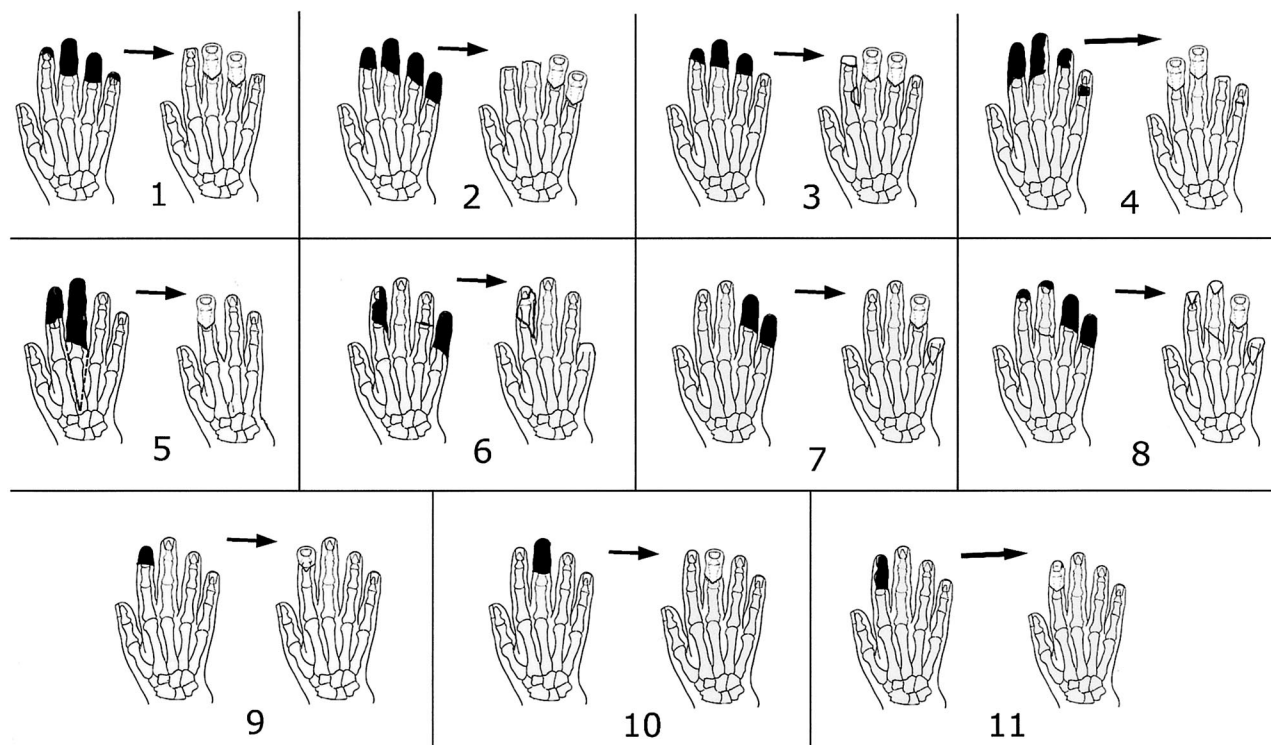


FIG. 2. Schematic representation of the patients of this series and the postoperative results. The damage is shown in *black*, and transplanted toes are shown in *white*.

after the injury; however, 4 months later his company forced his retirement. Patient 9, who at the time of the accident was a student electrician, is presently working and uses his reconstructed finger, even in precise activities.

Recovery of sensibility was at least protective, and the average two-point discrimination varied from 5 to 15 (average, 10 mm). We expect it to improve because the follow-up is short in some patients. Motion at the native proximal interphalangeal joint averaged 101 degrees (range, 120 to 70 degrees) in those patients treated acutely or subacutely. Three patients (3A, 9, and 11) sustained a degloving type injury on the fingers, and the distal interphalangeal joint and tendon apparatus could be preserved. The range of these preserved distal interphalangeal joints averaged 70 degrees. In contrast, the transferred distal interphalangeal joints had 7.5 degrees on average (range, 0 to 40 degrees). Grip strength was restored in most patients (Table II).

Cosmetic Results

Subjective cosmesis was also assessed on a visual analogue scale (Table II). Despite the fact that the toe aspect is far from a normal finger, patients gave a score of 8.95 on average.

We have attempted to compensate for the bulbous appearance by advancing a triangular flap on the opposite side of the pedicle from the finger, aiming at a Y-V widening effect, and by including a minimal amount of fat with the veins.

All patients would recommend and would repeat the operation. Interestingly, patient 2 thought that much had been wasted by delaying the operation. This same patient also thought that it would have been beneficial to transfer more toes to improve his grasp.

DISCUSSION

When dealing with multidigit injury, we have found it helpful to assess the damage and set, from the very beginning, a goal to be achieved. We have divided the possible end results into four types (Fig. 1): normal hand, acceptable hand, unbalanced hand, and crippled hand. Pursuit of a normal hand (four fingers with normal length and sensation and a normal thumb) is not always justified in a laborer. The surgeon should, however, expend all efforts to achieve an acceptable hand, one that is so from an aesthetic and functional standpoint for the patient and the others. An acceptable hand should have, apart from a thumb, at least three

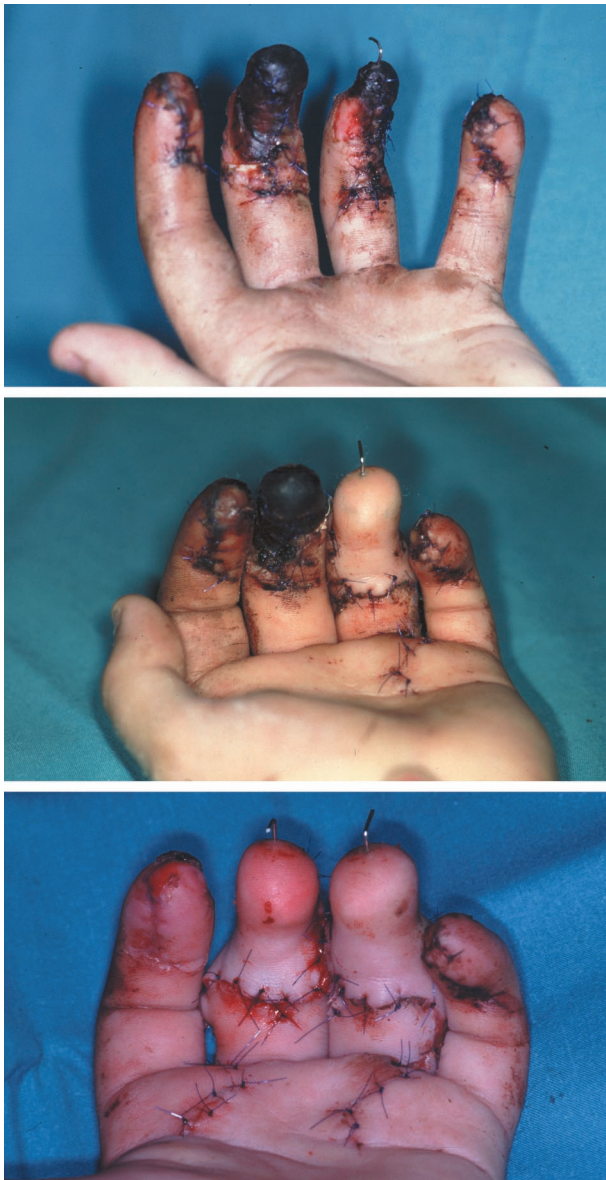


FIG. 3. Patient 1. (Above) Preoperative view, at the time of referral, 15 days after sustaining a crush. Note necrosis of the middle and ring fingers up to the middle finger crease. Primary closure would require amputation proximal to the proximal interphalangeal joint. (Center) Postoperative view a week after the first transfer and before the second. Note the middle finger stump is protected by the necrotic finger ("dry technique"). (Below) After the second operation.

fingers with normal motion at the proximal interphalangeal joint, with at least protective sensation, and with as much length as possible distal to the proximal interphalangeal joint. But more importantly, the hand should be harmonious in length. The proportioned length of the fingers should not be disregarded, as even minimal shortening in one finger is noticeable and gives a mutilated aspect (unbalanced hand). A hand with only two function-

ing fingers is limited from a cosmetic and functional standpoint (crippled hand). This schema helps us in the decision-making process. We try to upgrade the hand from a crippled or an unbalanced hand to an acceptable or near-normal hand.

Finger amputations proximal to the proximal interphalangeal joint can be dealt with in several ways, from simple remodeling to ray resection or cosmetic prostheses. Ray amputation is, in our opinion, the best alternative for single-digit amputation proximal to the proximal interphalangeal joint. Nevertheless, it has no role when more than one finger has been amputated. Finger prostheses provide high satisfaction from a cosmetic point of view.¹⁸⁻²⁰ Unfortunately, they do not have enough stability to participate in prehension²⁰ or even mild activities,¹⁹ although this limitation may be improved with advances in osteointegration.²¹ Moreover, they lack sensation, are expensive, and require renewal every 3 years.²⁰ Toes do have a major role in proximal amputations in cases of major trauma and multidigital amputations such as the metacarpal hand,^{3,4} but they are not the panacea either. When placed on top of the proximal phalanx, they are a nuisance if the rest of the hand is functional, as they are too short and have little motion.^{3,22-24}

Therapeutic alternatives for amputations distal to the proximal interphalangeal joint are similar to those referred to above, but two differences should be underscored. For a correct fit, cosmetic prostheses do require the presence of intact condyles in the middle phalanx; otherwise, they have to be held proximal to the proximal interphalangeal joint,¹⁸ sacrificing the critical motion of that joint (all patients in our series would have had a functioning joint eliminated). Toes are, in this scenario, long enough to attain a normal digital arcade (see below). Moreover, even if the motion at the transferred toe is minimal, the impact on the final function is negligible, as the contribution to the full arc of digital flexion of the distal interphalangeal joint is marginal.²⁵

Reconstruction of finger amputations distal to the proximal interphalangeal joint in laborers has not received much attention in the literature. This is surprising because finger losses distal to the proximal interphalangeal joint are, in our experience, an important source of disability and early retirement in capable workers. In our environment, rarely does a patient with two finger amputations at the

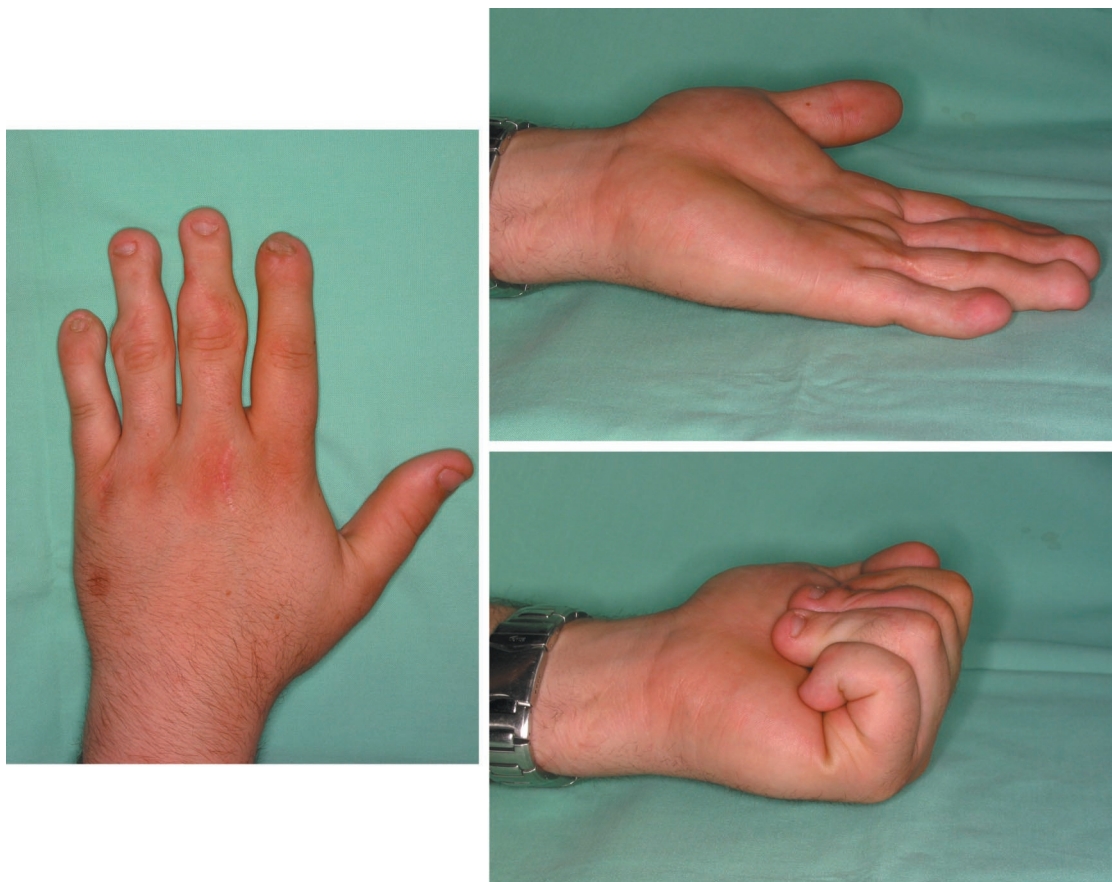


FIG. 4. Result 5 years after the reconstruction.

base of the middle phalanx return to a full-duty job, or to any type of heavy work if the affected hand was dominant and/or the injury occurred at work.

Indications

If the proximal interphalangeal joint is normal or reconstructible, the surgeon should at least provide the patient with the minimum, an acceptable hand. Therefore, in our opinion, it is an absolute indication to transfer a single toe when two fingers have been amputated or two toes when three fingers have been amputated, irrespective of the age of the worker and the type of work, provided he or she is fit for the operation.

Once an acceptable hand has been achieved, with one or two toes transferred, how do we decide to proceed to further reconstruction, i.e., when do we decide to pursue a four-fingered hand? In case of two finger amputations, we favor reconstruction of both fingers in central hand defects. Even single losses, when centrally located, are very obvious (unbalanced hand). However, lack of a lateral finger, particularly the fifth, is more easily dis-

guised. When dealing with lateral defects, index and middle or ring and small, we try to reconstruct the most central defect only, the middle or the ring, although we are sensitive to patient wishes. We have been reluctant to transfer three toes, a second toe from one foot and the second and third toes from the other, to avoid a major aesthetic sequela in the foot, and we have accepted less perfect results provided a harmonious hand was achieved.

The indication of the procedure in single-finger amputations in laborers is relative, and we try to be selective. We choose patients who are nonsmokers, younger than 40 years old, and willing to achieve a normal hand. Again, the procedure is more indicated in central defects than in lateral defects. We have found an indication in major losses of the index finger when part of the radial pulp is preserved (cases 6 and 11; Figs. 5 and 6).

Timing

The reconstruction should be performed as soon as possible, and the benefits of early reconstruction have not been highlighted

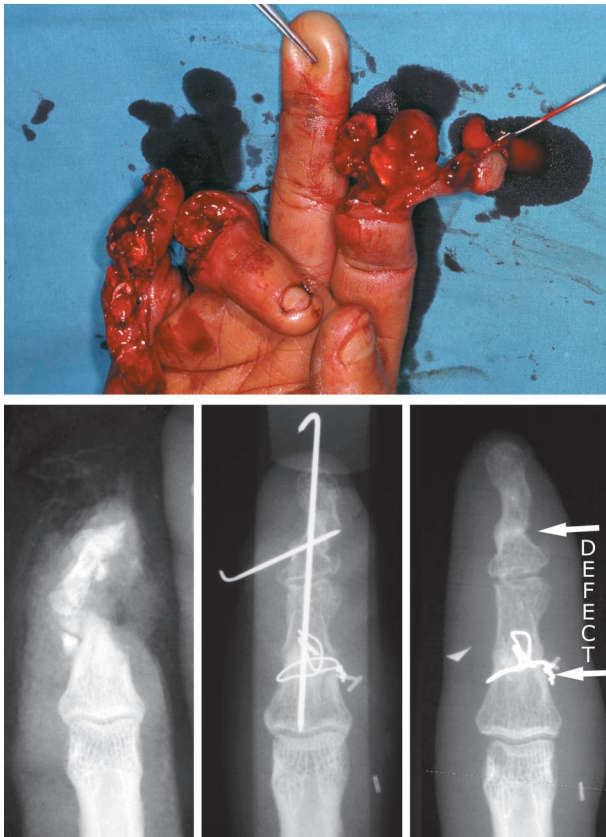


FIG. 5. Patient 6. (Above) Preoperative view of a 38-year-old construction worker who sustained a saw injury and was referred primarily. Note amputation of the small finger at the proximal phalanx level and concomitant injury on the ring. (Below) From left to right, preoperative radiograph, and radiographs taken 4 weeks and 1 year postoperatively (arrows point to the defect). Despite the severe damage of the middle and distal portions of the index, the proximal interphalangeal joint is preserved.

enough in the literature; only Wei et al.^{12,26,27} comment on the absence of problems if the operation is performed early. There are, however, true advantages when the transfer is done primarily. It avoids intermediate interventions to achieve closure while awaiting the definitive operation, and it allows for salvage of critical structures that would require sacrifice if the operation is performed secondarily. In our series, the following would have been wasted: proximal interphalangeal joints (cases 1A, 1B, 4A, 4B, and 5); distal interphalangeal joints (cases 3A and 9); and full digits (cases 6 and 11). Apart from these, some flexor tendons would have retracted, thereby losing their ability to function properly. The transfer also allows early rehabilitation of the hand, which has been shown in other fields of hand surgery to be very beneficial.^{28,29} The latter is also supported by the fact that the only patient who did

not achieve an acceptable range of motion at the proximal interphalangeal joint, even after tenolysis, underwent the delayed reconstruction.

Demirkan et al.¹² warn that early reconstruction, although safe, does not allow an intervening mourning period and may create unrealistic expectations. As they advise, prior counseling is imperative, but in any circumstance, the surgeon should recommend the reconstruction where appropriate and accept a more demanding patient. The benefits of early toe transfer cannot be emphasized enough.

Technical Issues

If the surgeon considers toe-to-hand transfer as an alternative, the stump deserves a different treatment than a conventional one.³⁰ Particularly, it should be underscored that primary closure would sacrifice structures that later may be useful, and it is not recommended at all. Our policy, while waiting for definitive reconstruction, or in between a toe transfer and the next toe, is to leave the necrotic part in situ to act as a biological dressing. We clean the traumatized part and suture it to the stump, as if it were alive. We avoid wetness with dry dressing changes as required to encourage the part to evolve to dry gangrene. This approach, which we have developed after seeing dry ischemic ulcers in equilibrium for months (no infection, no progression), allows maximum preservation of proximal structures while waiting for definitive toe transfer. Immediate débridement without coverage is a mistake in this scenario, as it leads to additional tissue loss due to desiccation and requires a second débridement before closure.

Foucher et al.^{5,24} and Kay and Wiberg¹⁰ have shown that it is feasible, without adding a plantar scar, to harvest the plantar system in continuity with the dorsalis pedis artery. For fear of increasing foot problems, we prefer³¹ to use the plantar system with a short stem (1.5 to 2.5 cm) when it is dominant, and we favor leaving intact the dorsalis pedis deep plantar arch in dorsal-dominant scenarios for the same reason.³² This policy has the disadvantage that the surgeon has to work with vessels of smaller diameters and short pedicles. In compensation, foot and hand dissection is quicker and less destructive.^{7,32,33} There are detailed presentations in the literature of techniques for dissecting the arteries and dealing with anomalies.^{10,16,31,33-35} At present, we prefer to start by

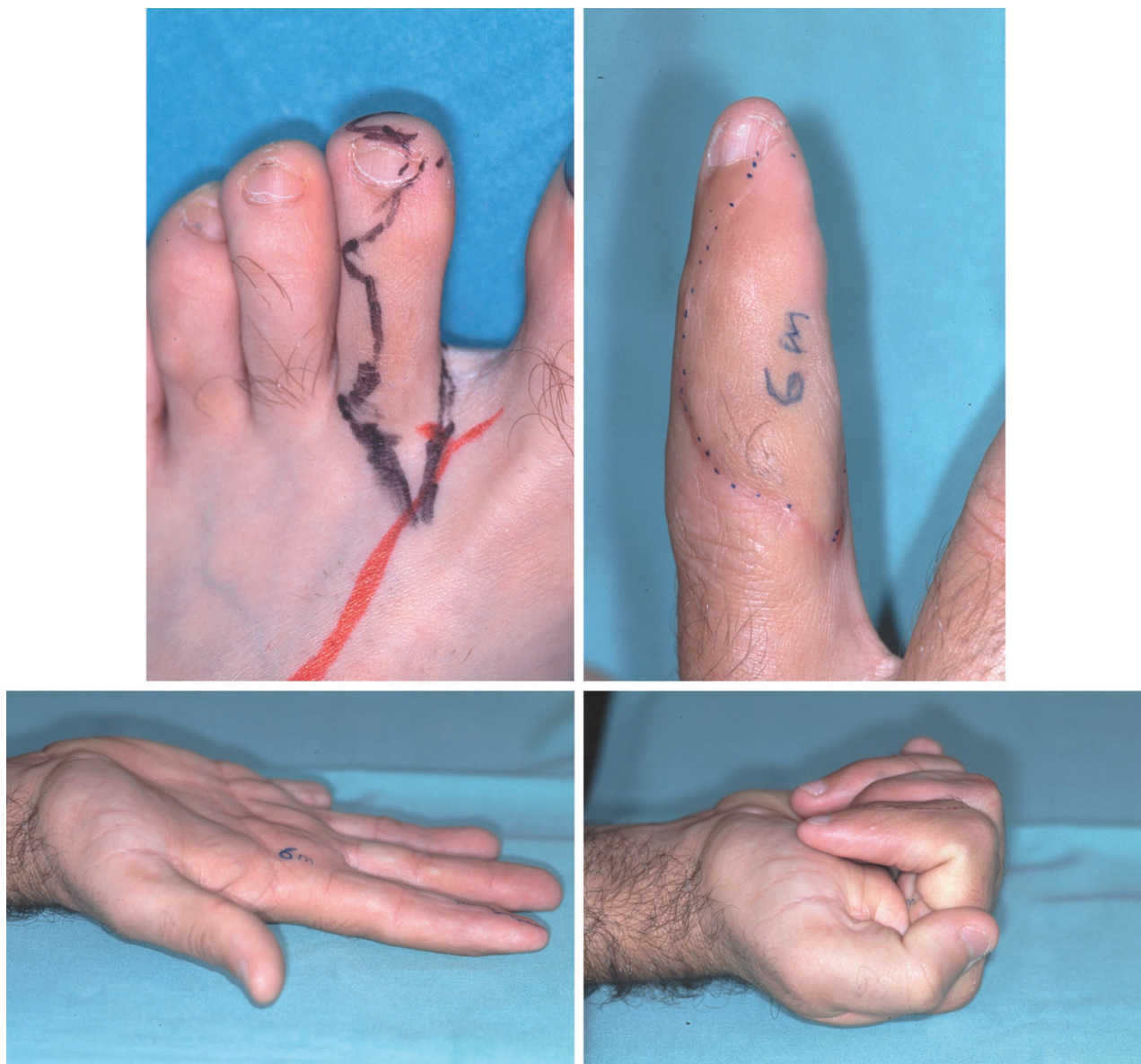


FIG. 6 Patient 6. (Above) Outline of the planned osteoarthrotendinocutaneous flap. Index finger 6 months later. (Below) Result at 6 months. The small finger has been amputated at the proximal phalanx.

isolating the digital artery distally and then proceed retrogradely as recommend by Wei et al.³³ and Kay and Wiberg,¹⁰ because this is the best way of dealing with anomalies at the distal communicating artery.^{16,36}

Arterial difficulties are minor compared with the complexity of dissecting the tiny veins at the distal toe. This part of the procedure can be made easier if the surgeon includes fat in between the veins. Unfortunately, this will create a chunky reconstruction and a poor aesthetic result. We recommend skeletonizing the veins from the very distal part of the toe, a tricky exercise that requires patience and ut-

most care to not tear those fragile vessels (Fig. 7).

To obtain a harmonious digital arcade, length discrepancies should be taken into account. In the average patient, the full phalanx of the middle and distal toes is equivalent to the distal third of the phalanx of the middle and distal fingers, but considerable variations exist. We recommend taking plain radiographs of the foot and both hands and using tracing paper to estimate the possible end result. We have compensated for shortness of the toe by interposing a nonvascularized slice of the proximal phalanx of the toe when required (Fig. 8).

TABLE II
Results

Patient	Follow-Up (mo)	PIP (degrees)	DIP (degrees)	2PD	Grip Affect/Norm (Kgr)	Return to Work (mo)	Objective*	Subjective (VAS)†	
								Functional	Aesthetic
1A	60	100	20	5	42/44	5	C⇒N	10	9
1B		100	0	5					
2A	20	55	0	11	28/38	§	C⇒A	8	9
2B		60	0	15					
3A	13	120	70‡	9	52/53	4	C⇒N	10	10
3B		110	20	13					
4A	9	75	0	9	32/52	4	C⇒A	6.5	6.5
4B		70	0	11					
5	46	95	10	11	18/20	8	C⇒A	9	8
6	27	105	0	7	57/61	6	C⇒A	9	10
7	24	110	0	7	46/50	3	U⇒A	10	10
8	6	90	0	15	18/28	5	C⇒A	8	8
9	40	115	60‡	9	52/50	3	U⇒N	10	9
10	24	100	40	7	56/52	4	U⇒N	10	9
11	9	120	80‡	13	50/53	2.5	U⇒N	9.5	10

PIP, proximal interphalangeal joint; DIP, distal interphalangeal joint; 2PD, two-point discrimination; C, crippled; U, unbalanced; A, acceptable; N, normal; VAS, visual analogue scale.

* The objective assessment refers to the improvement from the preoperative to postoperative status according to our classification: crippled, unbalanced, acceptable, normal (see text for details).

† Visual analogue scale: minimum = 0; maximum = 10.

‡ This motion is at the native distal interphalangeal joint.

§ This patient retired.

Inclusion of proximal interphalangeal joint of the toe for lengthening purposes is not recommended, as it would increase the number of joints, making the construct less stable.

The distal part of the second toe is bulbous. This is more pronounced in some toes where the distal interphalangeal crease acts as a band creating a stricture. Even if there is a mild bulbous appearance, if the toe is transferred to the hand without any modification, a “cobra deformity”¹⁷ will be unavoidable. Wei et al.¹⁷ managed this problem by star opening the finger stump to redistribute the transition. We have had some success by interposing a V flap from the finger in the contralateral side of the pedicle of the toe, remedying a Y-V release effect. This increases the diameter of the mid-portion of the toe, making the transition more even (Fig. 9). As stated above, exact tailoring of the toe to the defect is critical in this respect, too.

Several authors,^{10,22,23} aiming to reduce the number of procedures and to avoid having to perform operations in scarred areas, prefer to do more than one transfer at a time. This plan has obvious advantages, but we prefer, at this moment, to transfer the toes sequentially, separated by a week, to avoid fatigue. To decrease the risk of thrombosis during the second toe transfer, we administer a bolus (3000 units) of heparin before tourniquet inflation, and we try

to keep ischemia time to a minimum during the second operation.

Results

The range of motion we obtained at the finger distal interphalangeal joint, formerly the toe distal interphalangeal joint, has been disappointing (7.5 degrees on average), keeping in line with other researchers.^{3,8,22–24} Although functional upgrading is possible by tenolysis,³⁷ we have been reluctant to reoperate on these patients, as there is a risk of vascular accident, and the contribution of the distal interphalangeal joint to full digital flexion is minimal. Interestingly, the range of motion at the proximal interphalangeal joint in our series is much better than in other studies: 95 degrees versus 42 degrees.^{22,26} The only explanation for this disparity that we have found is that in the Wei et al. series most reconstructions were delayed more than 6 months, as in our worst result (case 2).

Subjectively, patients rated the results high from a functional and cosmetic standpoint. This reflects, apart from a sense of well-being, a gratitude to the surgical team, as the indication for reconstruction was considered useless by the insurance companies. The carriers considered that the patients were going to retire even after toe transfer, so there was no benefit in approving the transfers. The fact is that most

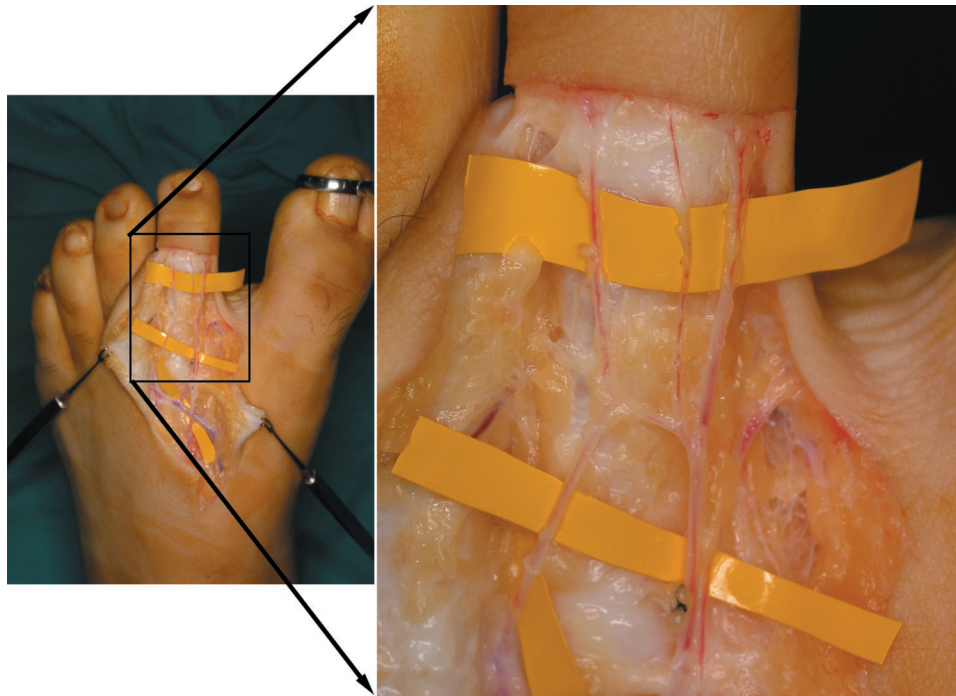


FIG. 7. Intraoperative view during dissection of the dorsal veins of the toe to highlight the minimal amount of fat included with the veins (*inset*, panoramic view). Radical skeletonization is critical to achieve a good cosmetic result.



FIG. 8. Details of the bony work needed to increase length and achieve a harmonious hand. (*Left*) Preoperative radiographs of patient 4. Note damage of both proximal interphalangeal joints. (*Right*) Radiograph taken at 6 months shows that an interpositional slice of nonvascularized proximal phalanx of the toe has been placed on the base of the middle phalanx of the third finger to lengthen the reconstruction by 0.8 cm. On the index finger, a defect involving two thirds of the circumference of the middle phalanx has been rebuilt with a nonvascularized segment of the proximal phalanx of the toe fixed with lag screws to avoid shortening the finger by 1.1 cm. In both digits, the flexor digitorum superficialis was detached by the injury and required reinsertion distal to the bone graft.

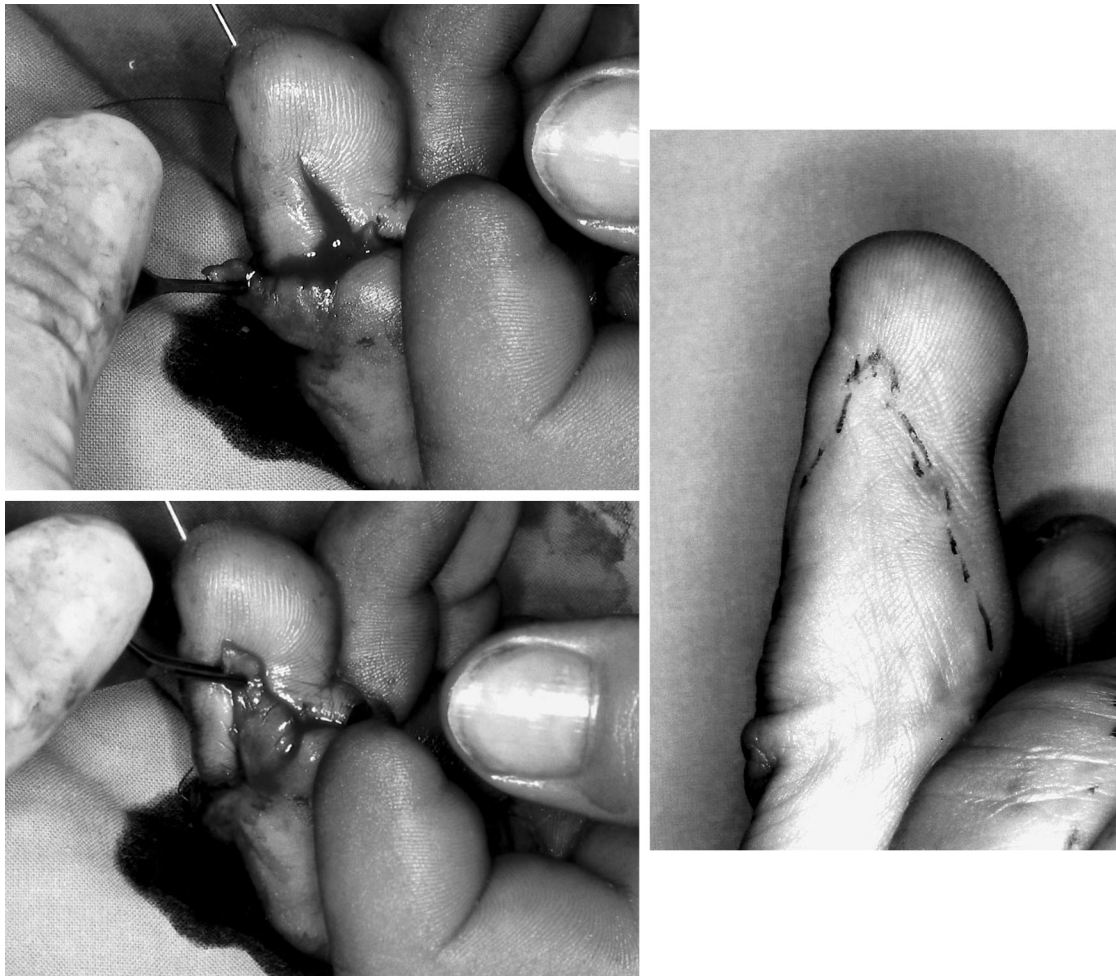


FIG. 9. (Left) Detail of the use of a dorsal flap to achieve the Y-V widening effect to relieve the stricture of the toes' distal crease and ease the transition from the finger to the toe. (Right) Result in patient 1.

of the patients went back to work, including eight with two or more finger amputations, and in this aspect, the technique of toe transfer is unsurpassed by other alternatives.

CONCLUSIONS

After assessing our experience, we believe that there are two groups of patients who benefit from toe-to-hand transfer, apart from the thumb. One group has severe mutilating injuries, and the goal is a basic or a tripod pinch. There will be obvious sequelae at the donor feet.^{38,39} The other has minor lesions, and the surgeon has the ability to achieve a reconstitution ad integrum with minimal donor-site morbidity. It has been our experience that toe transfer in amputation distal to the proximal interphalangeal joint does restore the ability of laborers to return to their previous employment, and we strongly recommend the proce-

cedure in cases of two or more finger amputations, even in work-related situations.

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