Upper Extremity Replantation

Ronald E. Tegtmeier, MD, George E. Omer, MD, Michael G. Orgel, MD,
Moheb S. Moneim, MD, and William C. Kilpatrick, MD

Denver, Colorado and Albuquerque, New Mexico

Replantation can be accomplished in several centers in the United States, and, in selected patients, can produce satisfactory function and appearance. This paper describes the selection of cases, and initial care of the patients and their amputated extremities.

Several centers in the United States now have the capability to replant extremities and digits. This report will describe the indications and procedures used at the Division of Hand Surgery, University of New Mexico.

A replantation center must have a team of surgeons with the capability of performing microvascular anastomosis in vessels down to 0.5 mm in diameter. This requires an operating microscope and special microsurgery instruments. The team must have the experience to decide when replantation is indicated, the technical ability to replant, and the judgment to make all important postoperative decisions.

Indications for Replantation and Factors Involved in Success

The decision for or against replantation must be based upon the level of amputation and type of injury, and upon age, life-style, and desires of the patient.

Replantation has been performed for amputations from the proximal forearm to distal fingers. Prosthesis provides less optimal treatment for these injuries because they cannot provide dexterity with sensibility. Replantation is rarely indicated in the lower extremity because available prosthetic limbs provide stable mobility. The more distal the amputation, ie, wrist to digits, the better the potential for nerve regeneration and the more satisfactory the result of replantation. Clean, sharply cut amputations have better prognosis than crushed or avulsed amputations. A severely injured extremity may be impossible to replant.

The sooner circulation is reestablished the better the prognosis. Current feeling is that an extremity can be replanted as much as 24 hours after amputation if kept cool, but only 6 to 12 hours if not cooled.

Younger patients are better candidates for replantation, as long as the vessels at the site of amputation are not under 0.5 mm. Their general healing potential and better adaption to nerve injury lead to more favorable results.

The general health, life-style, and longevity of the patient must be taken into consideration. The patient should not have other injuries which require more urgent attention, and should be in generally good health. Life-style is important; for example, a violinist may be a candidate for replantation of a distal finger, whereas a retired elderly person would not be.

Finally, social and economic considerations enter into the decision for replantation. Replantation will involve about two weeks in the hospital, two months or more before the extremity can again be used, 1 to 1½ years before maximum return of function is realized, and at least $5,000 in medical expenses. Patients who cannot afford the time off work or expenses usually should not be considered for replantation for some amputations, such as a single digit.

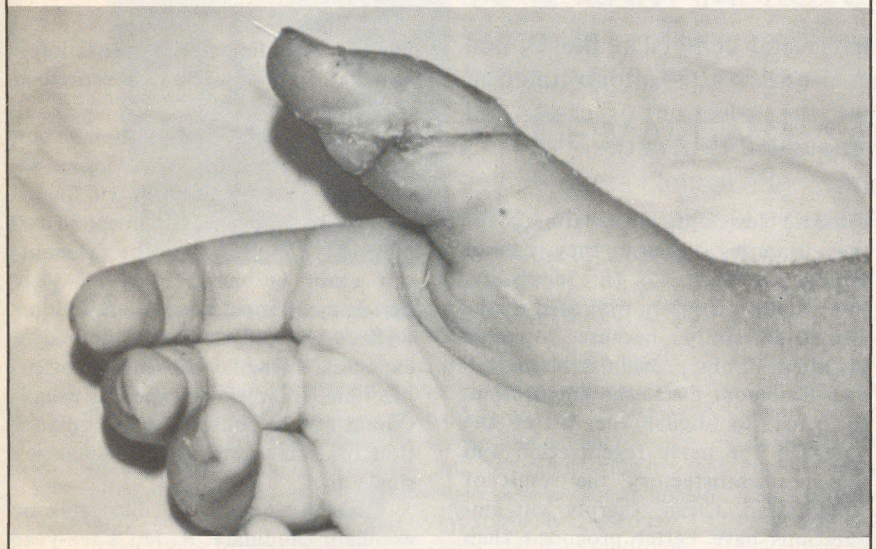
Case 1 (Figure 1) illustrates an excellent candidate. K. M., a ten-year-old boy, amputated his right thumb sharply in a wood chopping accident. The thumb was cooled, and the patient reached the operating room within two hours. Within six hours of the accident, the circulation was reestablished. A total of four veins and two arteries were reanastomosed (two veins per artery produces optimal circulation). Both digital nerves and both tendons were also anastomosed primarily. The patient had an unremarkable postoperative course, and as a young child with a distal injury, is anticipated to have excellent functional return.

Initial Care

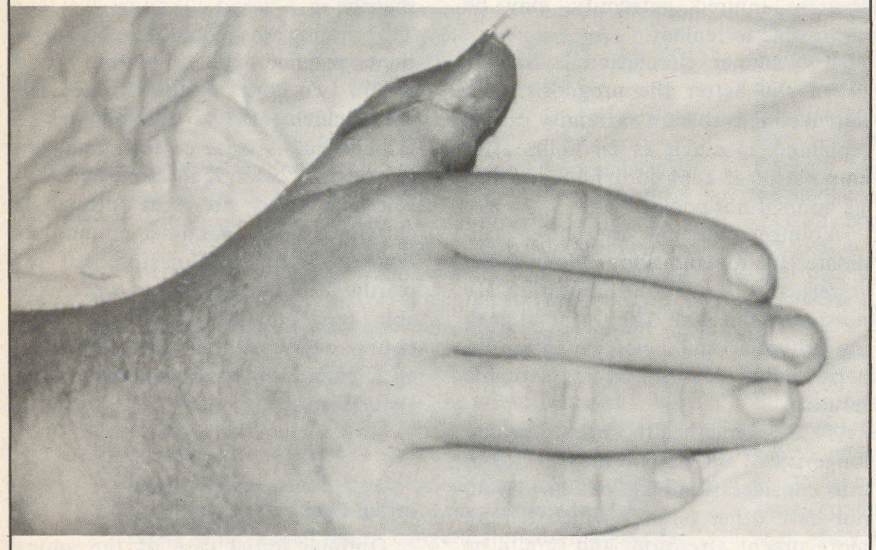
Optimal initial care of the amputated extremity includes the following: It should be rinsed with normal

From the Division of Hand Surgery, Department of Surgery, University of New Mexico, Health Sciences Center, Bernalillo County Medical Center, Albuquerque, New Mexico. Requests for reprints should be addressed to Dr. R. E. Tegtmeier, 2701 West 84th Avenue, Suite 201, Westminster, CO 80030.

A



B



C

Figure 1. Case 1. Ten-year-old K. M.
A. Amputated Right thumb
B&C. Thumb two months after replantation

saline, wrapped in saline moistened gauze, and placed in a plastic bag which is then sealed and immersed in iced saline. This keeps the extremity cool and moist without freezing it. Vessels should not initially be irrigated, as was the practice in early years, since this may produce capillary injury. The stump should be cleansed briefly and wrapped in saline soaked gauze. The patient should be given tetanus prophylaxis if indicated, oral intake is forbidden, and fluid replacement is given intravenously if blood loss has been significant.

The replantation team should be contacted so that they can confirm the replantation potential, advise on starting antibiotics, and prepare for the patient. The patient should be transported to the center with minimal delay.

Operative Procedure and Postoperative Care

The microsurgical technical details have been well described in many recent sources.[1-3] Only the general operative care will be outlined here.

The replantation is performed under axillary block with sedation, or under general anesthesia for younger patients. The procedure usually requires five to nine hours. One surgeon prepares the amputated extremity while another prepares the stump. The preparation consists of debridement and identification of structures to be repaired. The ends of any crushed or ragged structures are trimmed back to a noninjured level, and the bones shortened to allow tension-free repairs of nerves and vessels. Fasciotomies may be indicated at the time of the original surgery. The order of reconstruction is usually bone, tendons, vessels, nerves, and then skin.

The postoperative care and judgment are the most difficult aspects of replantation. This is partly due to the fact that insufficient clinical experience is available upon which to base decisions. Whether to use postoperative anticoagulants, which ones to use, when to begin them, and how long to use them are questions which are beginning to be answered as larger series are compiled. A great deal of individual judgment is still required.

At the Division of Hand Surgery, University of New Mexico, post-

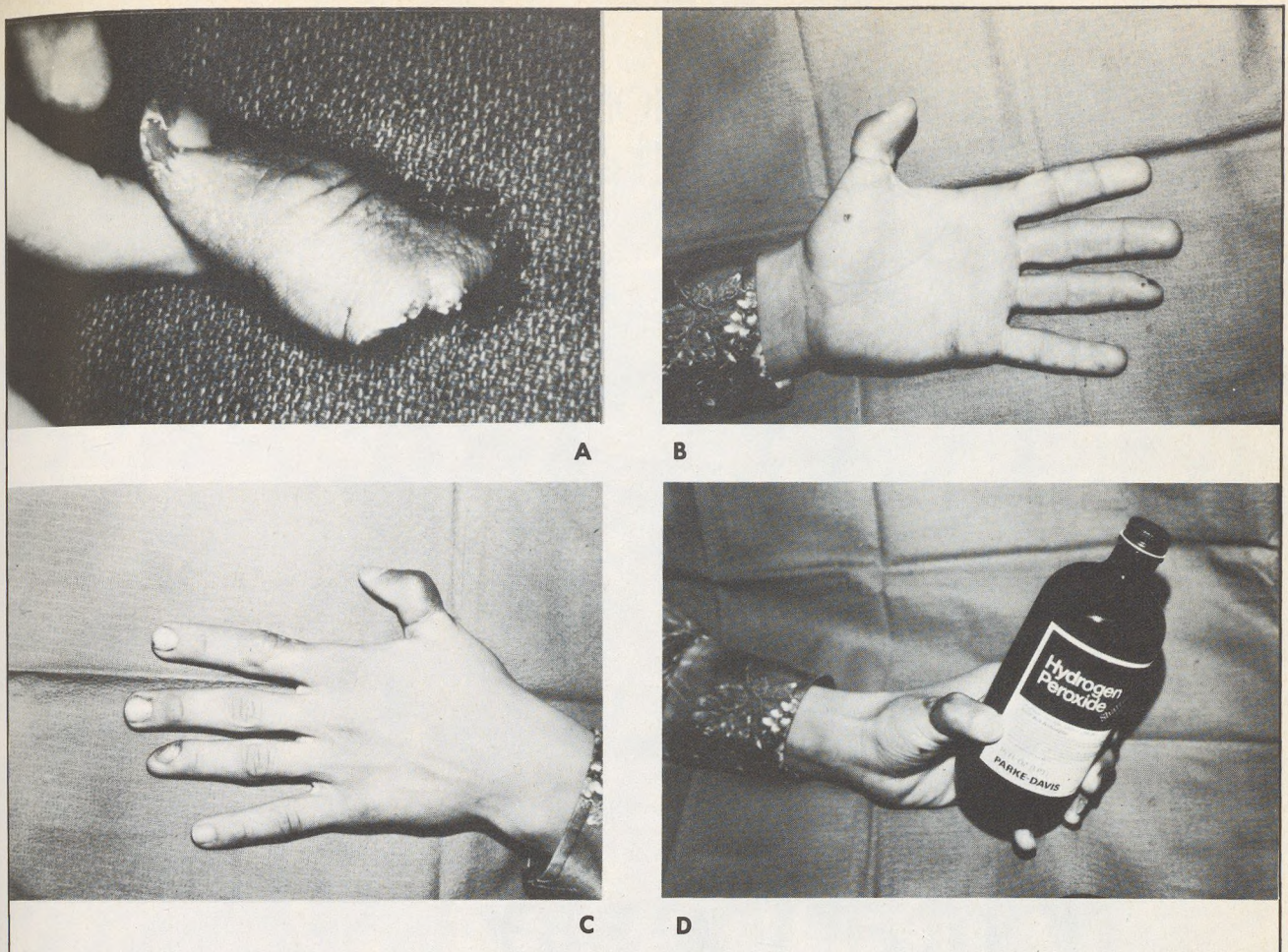


Figure 2. Case 2. Eighteen-year-old K. N.
A. Amputated left thumb
B&C. Thumb eight months after replantation
D. Demonstration of function of replanted thumb

operative anticoagulants are individualized for each patient. For digital replants, 10% Dextran 40 is begun intraoperatively and continued for three to four days. Heparinization is begun within 24 hours of surgery and continued for 10 to 12 days, and Aspirin (five grains four times daily) is continued for 10 to 14 days. Dipyridamole (Persantine) or chlorpromazine (Thorazine) are occasionally used in the postoperative period. More proximal replants may not require anticoagulants. Most patients are maintained on wide-spectrum antibiotics. The risk of vascular problems exists up to the 12th day,[1] and occasionally an attempt must be made to improve circulation in an avascular or congested replanted extremity. The vascular anastomosis may have to be redone or a fasciotomy performed. All available guidelines must be employed in making the decision to reoperate: color, temperature, blanching, and refill of the extremity, Doppler ultrasound, and occasionally infrared studies (arteriograms should be avoided).

Results

At the Division of Hand Surgery, University of New Mexico, viability has been maintained in 75 percent of totally amputated replanted extremities, which is consistent with other centers around the world.[1-3]

Return of sensibility and motor function seldom reaches normal. Well-selected patients, however, should achieve return of useful function as illustrated in Case 2:

K. N. (Figure 2), an 18-year-old carpenter, sustained an electric saw amputation of his right thumb. The patient and thumb were flown to the University of New Mexico shortly after injury, and his thumb was replanted. Eight months after replantation he has a stiff but stable interphalangeal joint, and he has protective sensibility. He has returned to using his thumb in his daily work as a carpenter.

References

1. Daniller AI, Strach B (eds): Symposium on Microsurgery. Saint Louis, C. V. Mosby Co, 1976
2. O'Brien B: Microvascular Reconstructive Surgery. New York, Longman Inc, 1976
3. Replantation Surgery in China, Report of the American Replantation Mission to China. Plast Reconstr Surg 52:476, 1973