A Global View of Digital Replantation and Revascularization

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KEYWORDS

• Digital replantation • Revascularization • Wide-awake surgery • Tissue defects in the hand • Complex hand trauma

KEY POINTS

- Survival rates of digital replantation vary in different regions and countries, and Asian surgeons see more challenging cases and have developed some unique methods.
- Replantation of multiple digits in one or both hands can follow a structure-by-structure method or a digit-by-digit method. For replanting all 10 digits, 3 or 4 teams should be organized.
- Flow-through flaps, often venous flaps, can be taken from the distal forearm or lower extremity to repair defects of soft tissues and arteries. A pedicled digital artery flap from the adjacent digit can also repair tissue defects and supply blood to the replanted digit.
- Replanting a multilevel severed digit, a digit in a newborn or young child, or a digit amputated distal to the distal interphalangeal joint is challenging, but attempts are routinely made in Asian hospitals. A dry replantation technique can be used in a multilevel severed digit, which reduces surgical time.
- Local anesthesia can be used for digital replantation; local anesthesia with epinephrine for digital replantation has been used in selected cases.
- A few extremely difficult digital replantations illustrate how surgeons have challenged themselves in pushing the limits of microsurgery in salvaging amputated digits.

INTRODUCTION

The early development of microsurgical techniques was built largely upon attempts and refinements of replanting the arm, hand, or digits. Half a century later, replantation techniques are mature, but globally variations or differences are seen in indications for deciding whether to pursue replantation and difficulties that microsurgeons would like to address. This review offers an analysis and global view on indications, current practices, and various other considerations about digital replantation and presents some of the most difficult and challenging cases to illustrate some of the technical triumphs of microsurgery (not necessarily functional triumphs).

To prepare this article, the lead author invited a panel of distinguished experts on replantation to join him in assembling materials: J.B.T. provided views of current indications, views, and collected success rates of digital replantation from colleagues or reports from different regions

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of the world, especially North America and Asia, and summarized the materials from the panelists; Z.T.W. collected from Chinese colleagues some of the most unusual and challenging digital replants; J.C. summarized reports on 10-digit replantation from the Chinese literature and presented his cases of digital replantation; and J.W. reported on the approach to wide-awake digital replantation in selected patients. This collective effort was intended to offer a global update on this common and yet often challenging area of microsurgery.

DIGITAL REPLANTATION: WHETHER TO UNDERTAKE AND HOW MUCH EFFORT TO EXPEND?

Replantation of a clean-cut amputation in the proximal half of a single digit is a well-established procedure. The indications are well described, and the essential methods are straightforward, without fundamental differences across regions. There are established principles for more complex and difficult amputations. However, in real-world practice, surgeons in different regions or different units of a given region or country execute these well-documented principles differently and are strongly affected by patients' desires and surgeons' skills, in deciding whether or how to replant. What the authors have learned in collecting materials for this article is striking. The patients' attitudes and surgeons' efforts are so diverse that surgeons in one country may actually have difficulty imagining what decisions and procedures are like in other countries:

1. Most individuals who have an amputated digit would wish for the digit to be replanted. However, when only a single digit was amputated but local tissue conditions are unfavorable and injuries are somewhat complex, European people and Americans of European heritage appear more easily accepting of not having a replantation or accepting ray amputation. If similarly complex injuries occurred in an Asian patient, the patient is usually more eager to have the digit replanted and much less willing to accept surgery to terminalize or ray amputation. Consequently, hand surgeons in the East tend to attempt much more complex replantation.
2. Most contraindications in textbooks are not real-world contraindications in the practice of many surgeons in the East. Often, the only contraindications in their practice are poor general conditions of the body and severe crush to the distal part of the digit. Replantation of distal fingertips, or in a very young child, or of amputation at 2 levels of a digit, or of 3 or more digits of one hand, is common. Eastern surgeons frequently challenge their own replantation capability, and some become very proficient at replantation as a result of frequently having to push the technical limits of microsurgery upon the request of patients. Many western surgeons would not attempt replantation given the above conditions.
3. The survival rate of finger replantation in the United States is currently 61%, and thumb replants have a survival rate of 74%.[1] Replantation in the United States is performed in all academic medical centers and some major regional hospitals, with well-established microsurgical centers seeing higher-than-average survival rates. In the United Kingdom, replantation success can vary from 20% to 70% depending on the centers and the seniority of surgeon performing the procedure.[2] In eastern Asian countries such as China, Japan, and Korea, the survival rate of digital replantation is generally greater than 70% to 80%. Replantation in China is often performed in midlevel local hospitals (eg, county hospitals may have excellent microsurgical teams), with replant survival rates equal to those in academic centers. In the East, replantation survival rates of 60% to 70% are considered low.
4. Improved health and safety standards in the United Kingdom have significantly reduced the number of cases being performed. For example, 20 years ago, surgeons in Chelmsford performed 46 cases over a 2-year period, and more recently, only 25 cases were performed in over a 5-year period with no change in indication.[2] The industrial environments are the primary source of amputated digits in the East; hence, the frequency of injury in general is far greater than in the Americas and Europe. It is often seen that, in a midlevel hospital (eg, a county hospital) in China, surgeons handle 2 to 3 digital replants each month and replant more than 30 digits a year; some larger centers perform replantations almost every day. In contrast, most academic medical centers in the United States have only 1 or 2 digital replantation surgeries in a month, and one hand surgeon may only replant 1 or 2 digits each year. Consequently, practice volumes and the experience of the surgeons are dramatically different, although they all are microsurgeons or are microsurgery trained. In the United States, high-volume hospitals are defined as having more than 20 replants per year, and high-volume surgeons are those who perform