

Our Strategy for Fingertip Amputation

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Abstract

From January 2005 to December 2008, we treated 59 patients with a total of 67 complete fingertip amputations. By statistically analyzing these 67 cases, we reported that up to subzone III (Ishikawa's subzone), replanted fingertips could survive with arterial anastomosis alone, and we established a new treatment strategy.

1. For cases with amputation levels subzones I to III, arterial anastomosis was performed under digital block and venous anastomosis if possible. If the venous anastomosis was not performed, care was taken to relieve postoperative congestion. General anesthesia was used in cases where the patient had difficulty in staying still, such as a child.

2. For cases with amputation levels more proximal than subzone IV, both arterial and venous anastomoses were performed. Venous anastomosis is essential and considering the possibility of a vein graft, operations were performed either under axillary block or general anesthesia.

From July 2012 to November 2014, we treated 21 patients with 22 fingertip amputations according to the new treatment plan.

Results: Amputation levels were as follows: subzone I, 10 fingers; subzone II, 7 fingers; subzone III, 1 finger; and subzone IV, 4 fingers. Overall replantation success rate was 95% (21 out of 22 fingers).

Conclusion: For the past two years, we have established a new treatment strategy for complete fingertip amputations, and obtained favorable outcomes. Depending on the situation of the patients and institutions, this strategy could become one of the treatment options.

Keywords: Fingertip amputation; Replantation; Arterial anastomosis; Strategy

Introduction

Among finger amputations, fingertip amputations when replanted successfully provide excellent esthetic and functional results with high patient satisfaction [1]. For this reason, we have treated amputations by attempting replantation unless otherwise requested by the patient. Replantation success rates obviously increase when both arterial and venous anastomoses are performed. However, circumstances in which we are limited to performing only an arterial anastomosis occur, such as, (1) unavailability of an adequate vein; (2) crush injury with tissue damage; (3) inability of the patient to tolerate the long surgical time; or (4) unavailability of the operating room staff. There were few sufficient data regarding at which level a replanted fingertip can survive solely on arterial anastomosis. Therefore we performed a statistical review of our clinical data, and reported that up to subzone III (Ishikawa's subzone), there is a high possibility of replanted fingertips surviving with arterial anastomosis alone [2]. Based on this result, we have established and acted upon a new treatment strategy, and hereby report the favorable outcomes. There have reports that in amputations distal from the DIP joint, sensory recovery is fairly well without nerve repair, so no attempt in nerve repair was made in any cases [3].

Materials and Methods

During the four years from January 2005 to December 2008, we treated 59 patients with a total of 67 complete fingertip amputations. A Fisher's exact test was performed to compare the survival rates of each group and a statistically significant difference was determined at $p < 0.05$. By statistically analyzing these 67 cases (Table 1), we established a new treatment strategy (Table 2).

1. For cases with amputation levels subzones I to III, arterial anastomosis was performed under digital block and venous anastomosis if possible. If the venous anastomosis was not performed, necessary care was taken to relieve postoperative congestion. General anesthesia

was used in cases where the patient had difficulty in staying still, such as a child.

2. For cases with amputation levels more proximal than subzone IV, both arterial and venous anastomoses were performed. Venous anastomosis is essential and considering the possibility of a vein graft, operations were performed either under axillary block or general anesthesia.

From July 2012 to November 2014, we treated 21 patients with 22 fingertip amputations according to the new treatment plan. None of the cases were reoperated for additional venous anastomosis. Fingertip replantations were performed in all cases regardless of the extent of damage unless the patient desired otherwise.

Results

Twenty-one patients were comprised of 16 males, 5 females, aged one to 77 (average age 36.0). Amputation levels were as follows: subzone I, 10 fingers; subzone II, 7 fingers; subzone III, 1 finger; and subzone IV, 4 fingers (Table 3). Type of injuries included one clean-cut finger, 14 crush cut fingers and 7 crush avulsion fingers. From the time of injury, shortest time to operation was one hour and the longest was 5 hours. Shortest operation was 50 minutes and the longest operation was 120 minutes. The overall replantation success rate was 95% (21 out of 22

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Amputation Level (subzone)	Arterial Anastomosis		Success Rate
	Only	With Venous Anastomosis	
I	10/11	0/0	10/11 (91%)
II	16/19	1/1	17/20 (85%)
III	7/8	9/9	16/17 (94%)
IV	0/2	15/17	15/19 (79%)
Total	33/40	25/27	58/67 (87%)

Table 1: Successful replantation rates among groups with arterial anastomosis only versus arterial and venous anastomoses (success/case). A statistically significant difference in the survival rate between Subzone I-III and Subzone IV was detected. *: p<0.05.

Amputation Level (Subzone)	Anastomoses	Anesthesia
I	Arterial Anastomosis Only	Digital block or General Anesthesia
II		
III		
IV	Arterial and venous anastomoses	Axillary block or General Anesthesia

Table 2: Treatment strategy for fingertip amputations.

Amputation Level (Subzone)	Arterial Anastomosis		Success Rate
	Only	With Venous Anastomosis	
I	10/10	0/0	10/10 (100%)
II	6/7	0/0	6/7 (86%)
III	1/1	0/0	1/1 (100%)
IV	0/0	4/4	4/4 (100%)
Total	17/18	4/4	21/22 (95%)

Table 3: Successful replantation rates among groups with arterial anastomosis only versus arterial and venous anastomoses (success/case).

fingers). One case with amputation level subzone II failed to survive. In this case, arterial anastomosis was performed but blood flow did not resume. A composite graft was performed but the fingertip finally necrotized.

Case Reports

Case 1

An 11-year-old girl had complete amputation of her left ring finger by getting her hand caught in a door. The injury was an avulsion crush injury, and the amputation level was subzone I (Figure 1a). In spite of her age, replantation was performed under digital block on the day of injury. One artery was anastomosed, distal to the arterial arch, for revascularization. Adequate veins were not available and no venous anastomosis was performed. The skin was sutured loosely to prevent congestion. The operating time was 80 minutes. Immediately after surgery, slight signs of congestion were seen (Figure 1b), but the overall outcome was excellent and she was discharged and returned to school after two weeks. Recovery at twelve months showed no limit in the range of motion, and sensory function returned to green (No.2.83) according to the Semmes-Weinstein test (Figure 1c).

Case 2

A 48-year-old man had complete amputation of his right ring finger from having his hand caught in a machine at work. The injury was an avulsion crush injury, and the amputation level was subzone

III (Figure 2a). Replantation was performed under digital block on the day of the injury. One artery was anastomosed, proximal to the arterial arch, for revascularization. Adequate veins were not available and no venous anastomosis was performed. The skin was sutured loosely to prevent congestion. The operating time was 90 minutes. Immediately after surgery, slight signs of congestion were seen (Figure 2b), but the overall outcome was excellent and he was discharged of the hospital after two weeks, and returned to work after two months. Recovery at five months showed mild deformity of the nail, but sensory function returned to green (No.2.83) according to the Semmes-Weinstein test (Figure 2c). Postoperative result after 3 years shows very little atrophy compared to the contralateral same finger (Figure 2d).

Case 3

A 3-year-old girl had complete amputation of her left middle finger by getting her hand caught in a door. The injury was an avulsion crush injury, and the amputation level was subzone I (Figure 3a). Due to her age, replantation was performed under general anesthesia on the day of injury. One artery was anastomosed, distal to the arterial arch, for revascularization. Adequate veins were not available and no venous anastomosis was performed. The skin was sutured loosely to prevent congestion. The operating time was 60 minutes (Figure 3b). The overall outcome was excellent and she was discharged after two weeks. Recovery at twelve months showed no nail deformity, and sensory function returned to green (No.2.83) according to the Semmes-Weinstein test (Figure 3c).

Discussion

Reported success rates of fingertip replantation ranges are from 70 to 90% [4-7]. The degree of tissue damage and technical aspects influence these numbers, but we have achieved a replantation rate similar or better to that of these reports.

There is general consensus that in subzones I and II of the Ishikawa

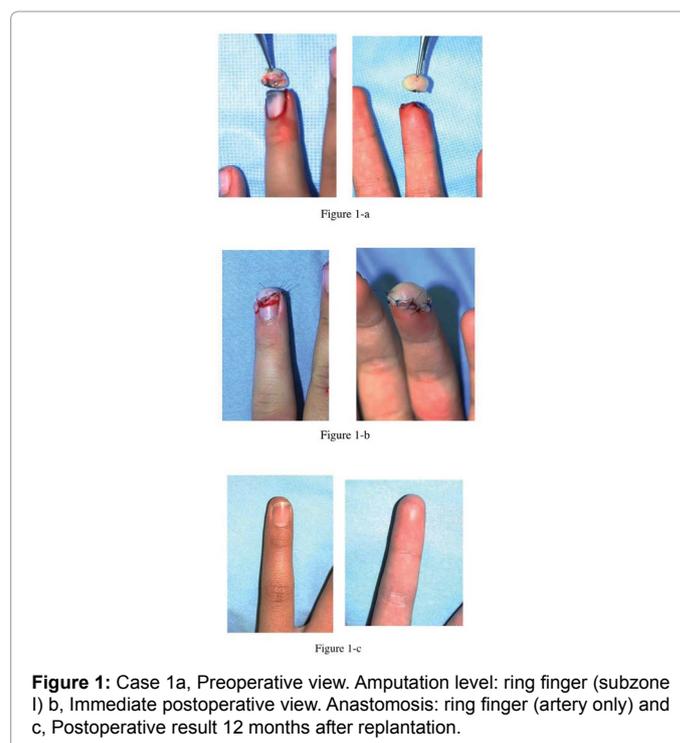
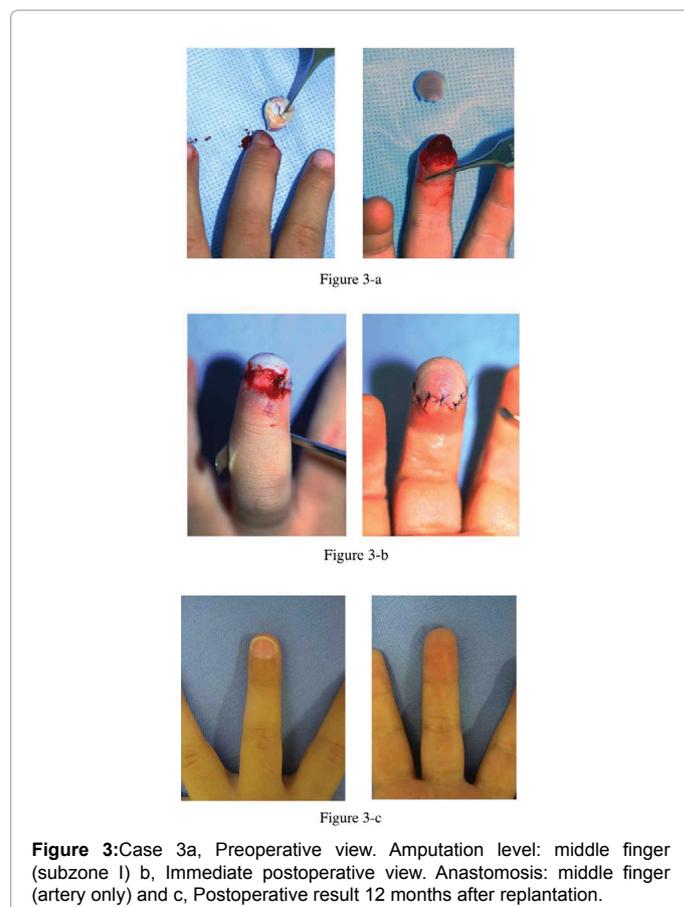
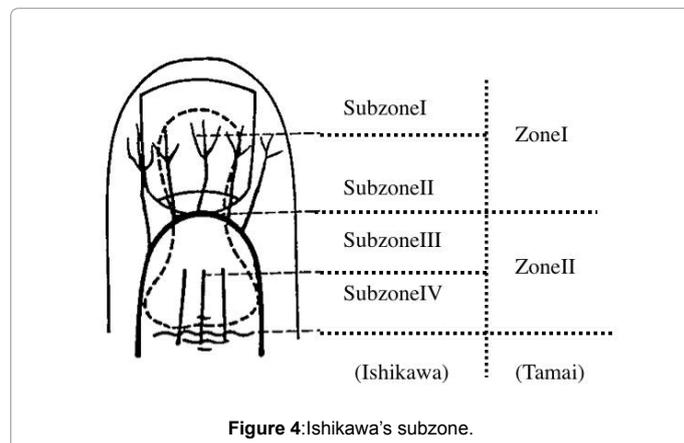


Figure 1: Case 1a, Preoperative view. Amputation level: ring finger (subzone I) b, Immediate postoperative view. Anastomosis: ring finger (artery only) and c, Postoperative result 12 months after replantation.



classification (Figure 4), venous anastomosis is not required for the survival of the replant, if the arterial anastomosis is done accurately [4,8-14]. However, there is a debate on the necessity of a venous anastomosis in subzones III and IV [4,8]. It is clinically important to determine this because it affects the preoperative assessment and planning in terms of number of vessels to anastomose, duration of operation, method of anesthesia, and patient consent. Thus, to gain insight, we retrospectively examined the survival rate of the 67 fingertip replantations we performed in the past four years. Our results indicate that the limitation of fingertip survival on arterial anastomosis alone is subzone III [2]. On the basis of this result, for cases of single amputation within subzones I to III, we established a minimally invasive treatment strategy prioritizing precise and accurate arterial anastomosis. We chose digital block as our method of anesthesia and attempt to operate in the limited time possible (~120 minutes) with a digital block. General anesthesia was used in cases where the patient had difficulty in staying still, such as a child.

We also believe that, if there is a suitable vein for anastomosis in these subzones that can be done within the time allowed, it is preferable to do so to improve outcome. If a venous anastomosis is not possible, the edges of the veins should still be approximated as much as possible as there are reports that this can induce recanalization of the vein [15]. When we are not able to anastomose a vein, care was taken to suture the skin loosely so that there can be drainage from the wound edges or we apply a fish mouth incision at the fingertip to attempt to resolve postoperative congestion.



For amputation levels more proximal than subzone IV, both arterial and venous anastomoses are essential for survival. If there is no suitable vein at the amputation site, every effort, including a vein graft, becomes necessary for successful replantation. Considering possible prolongation of operation time, an axillary block or general anesthesia should be chosen for these cases.

Fingertip amputations can sometimes survive as composite grafts, but with long-term follow-up, results tend to show a shortened finger [16,17]. The degree of tissue damage becomes the determining factor, but at our institution, we believe that replantation is the best choice of treatment with less chances of shortening or atrophy of the fingertips,

in the long run. We perform composite grafts only after attempting a replantation and when there is no artery to be anastomosed.

Conclusion

For the past two years, we have established a new treatment strategy for complete fingertip amputations, and obtained favorable outcomes. Depending on the situation of the patients and the institutions treating them, this strategy could become one of the treatment options.

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