

Original Article

A retrospective study of retrograde versus antegradepalm arteriovenous anastomosis in the distal fingertip replantation

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Abstract: Although replantation of fingertip is technically possible, advances in microsurgery have made salvage of amputated fingers a commonly performed procedure. In the present study, we aimed to evaluate the functional outcomes after retrograde (RAA) versus antegrade (AAA) palm arteriovenous anastomosis in the distal fingertip replantation. The results showed that survival rate, appearance and digits growth situation in RAA group were better than all of them in AAA group. Moreover, the 2-point discrimination in RAA and AAA group was 4.7 mm (SD = 1.4 mm) and 9.3 mm (SD = 2.6 mm) respectively, and there were significant differences between RAA and AAA group ($P < 0.01$). Furthermore, touch, algnesia and TAM in RAA group were better than all of them in AAA group. In conclusion, we found RAA or AAA provided a reliability of palmar arteriovenous anastomosis in the distal fingertip replantation. RAA treatment was better than AAA treatment to obtain ideal clinical outcomes such as survival rate, appearance and digits growth situation.

Keywords: Finger amputation, hand surgery outcomes, distal fingertip replantation, palm arteriovenous anastomosis

Introduction

Fingertip injuries and amputations are common injuries encountered in the emergency department of any major hospital. The clinical treatment options range from conservative management, local flaps to replantation of the amputated part [1]. Replantation of the fingertip when successful provides excellent cosmetic outcome by maintaining the digital length, preserving the nail and improving function. It can provide a high degree of patient satisfaction [2]. However, replantation of amputated fingertips is a technical challenge for the microsurgeon if distal arterial vessels are not available or are unsuitable for anastomosis [3, 4]. Arteries are thicker and they seem to get avulsed more easily than thinner veins. This is a common observation in avulsions, where the palmar and lateral veins are often available while the arteries are difficult to locate [4, 5]. Previous studies indicate that revascularization of amputated digits via an afferent palm arte-

riovenous anastomosis is a reliable alternative in digital replantation if distal arteries are unavailable for anastomosis [4, 6].

Although replantation of fingertip is technically possible, they are not regularly done due to the presumed complexity of the procedure and doubts about the outcome. In the present study, we aim to elaborate the functional outcomes of retrograde and antegrade palm arteriovenous anastomosis in primary treatment of patients with avulsion distal fingertip. A high survival rate of replanted tissues and good functional results were achieved by retrograde palm arteriovenous anastomosis as compared to antegrade palm arteriovenous anastomosis.

Materials and methods

Patients

A total of 200 digits in 117 patients were collected from the First Hospital of Qinhuangdao (China) between October 2010 and June 2015.

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Table 1. Patients' characteristics

	RAA (n = 55)	AAA (n = 62)
Age (years)	35.8 ± 6.7	34.2 ± 5.9
Male	38	49
Female	17	13
Average visit time (hours)	1.7 ± 0.8	1.6 ± 0.7

RAA, retrograde palmar arteriovenous anastomosis group; AAA, ante-grade palmar arteriovenous anastomosis group.

Table 2. Transplanted survival rate, appearance and digits growth situation in RAA and AAA group

Group	Digits	Survival numbers	Appearance		Digits growth situation	
			Well	Poor	Well	Poor
RAA	100	96	89	11	91	9
AAA	100	80	72	28	75	25
χ^2 value		9.28	7.17		5.1	
P value		0.002	0.07		0.02	

RAA, retrograde palmar arteriovenous anastomosis group; AAA, ante-grade palmar arteriovenous anastomosis group.

100 of those digits were replanted using retrograde palmar arteriovenous anastomosis (RAA Group), and the rest of the digits were replanted using antegrade palmar arteriovenous anastomosis (AAA Group). Patients' characteristics are summarized in **Table 1**. Retrograde or antegrade palm arteriovenous anastomosis operation were established as described previously [1, 7].

Immediate postoperative follow-up

The postoperative protocol included hand elevation, bed rest for 4 days, low-molecular-weight heparin (5000 IU intravenous over 24 hours) and 100 mg of oral acetylsalicylic acid per day. All patients started rehabilitation 6 days after surgery.

Follow-up

Patients were followed for an average of 12 months (range from 6 months to 20 months). In all patients, survival rate, appearance and digits growth situation was recorded, along with static 2-point discrimination, sharp/blunt discrimination and TAM at the last follow-up. All patients were also asked about their satisfaction with the final result and if they would recommend this procedure.

Statistical analysis

The data from these experiments were reported as mean ± standard deviation (SD) for

each group. All statistical analyses were performed by SPSS version 17.0 software. Statistical differences between two groups were determined using Student's t-test. Patients' clinico-physiological variables were analyzed by the χ^2 test. Differences with P value of < 0.05 were considered statistically significant.

Results

First, survival rate, appearance and digits growth situation in RAA and AAA group were estimated. The results showed that survival rate, appearance and digits growth situation in RAA group were better than all of them in AAA group (**Table 2**). Moreover, no atrophic changes were seen in any of the replanted digits, and all bones healed within 8 weeks of replantation. Next, we will be comparing the differences of therapeutic efficacy between RAA and

AAA group. The 2-point discrimination in RAA and AAA group was 4.7 mm (SD = 1.4 mm) and 9.3 mm (SD = 2.6 mm) respectively, and there was significant differences between RAA and AAA group ($P < 0.01$). Furthermore, touch, algnesia and TAM in RAA group were better than all of them in AAA group (**Table 3**). No patients had signs of neuropathic pain or cold intolerance at the last follow-up. At the last clinical visit, greater than 90% of patients were very satisfied with the outcome and would recommend the procedure (**Figure 1A-C**). Interestingly, after 12 months of observation, there were significant differences in effects of the two groups.

Discussion

Hand and digital injuries account for > 4.8 million visits/year to emergency departments in the USA [8]. Such injury is associated with disfigurement and disability, bringing functional, psychosocial, and financial consequences. However, advances in microsurgery have made salvage of amputated fingers a commonly performed procedure. Survival of replanted digits has become fairly reliable, with survival rates estimated to be 80%-90% in the literature [9-11]. Moreover, a meta-analysis indicates that replantation of distal digital amputations shows an overall survival rate of 86% [3]. In our study, we found that the mean survival of complete finger avulsion replants in RAA and AAA group is 96% and 80%, and begins to sur-

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Table 3. Differences of therapeutic efficacy between RAA and AAA group

Group	Digits	2-point discrimination (mm)	Touch			Algesia			TAM	
			Well	Moderate	Poor	Sensitive	Normal	Dull	Well	Poor
RAA	100	4.7 ± 1.4	59	30	11	1	86	13	84	16
AAA	100	9.3 ± 2.6	46	32	22	4	63	33	69	31
χ^2 value		10.25		6.39			7.76		5.35	
P value		< 0.01		0.018			0.025		0.021	

RAA, retrograde palmar arteriovenous anastomosis group; AAA, antegrade palmar arteriovenous anastomosis group; TAM, total active motion.

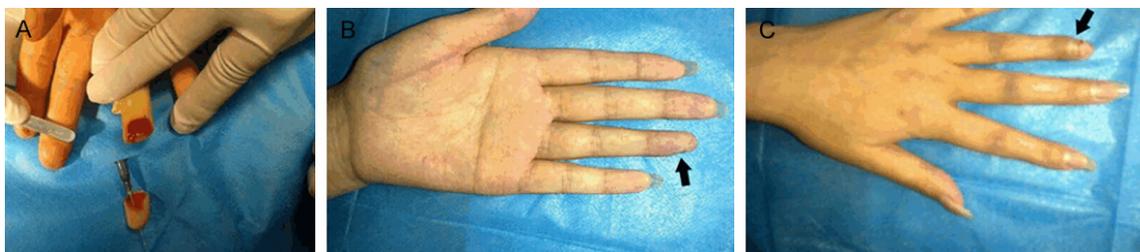


Figure 1. Amputated fragment prepared for replantation (A), patients treated with retrograde palm arteriovenous anastomosis frontal palm (B) and reverse palm (C) in good condition.

pass expected survival of replantations in general. Intriguingly, the survival rate in retrograde palm arteriovenous anastomosis was significantly higher than antegrade palm arteriovenous anastomosis in the distal fingertip replantation. These results suggested that retrograde palm arteriovenous anastomosis was likely to be the future treatment and a new breakthrough of distal fingertip replantation. A series of five digits successfully replanted by anastomosing a proximal digital artery to a distal palmar vein in order to re-establish arterial inflow [4]. Moreover, of the 15 other cases published by several authors using this technique, 13 were successful, with necrosis reported in two thumbs [4, 6, 12]. In this work, we showed that survival rate, appearance and digits growth situation in RAA group were better than all of them in AAA group.

Distal replantation performed at institutions that specialize in microsurgery and specifically tailored to the level of injury is associated with good survival, function, patient satisfaction and superior aesthetic outcome. More prospective data are needed to evaluate the cost of treatment, psychological outcomes, and functional outcomes of distal replantation [2, 13]. In the present study, therapeutic efficacies, such as 2-point discrimination, touch, algesia and TAM, between RAA and AAA group were compared. The results demonstrated that the

2-point discrimination in RAA and AAA group was 4.7 mm (SD = 1.4 mm) and 9.3 mm (SD = 2.6 mm) respectively, and there was significant differences between RAA and AAA group. Furthermore, touch, algesia and motor functions in RAA group were better than all of them in AAA group. These results suggested that there were significant differences in therapeutic efficacies of the two groups. Moreover, we found that the TAM of complete finger avulsion replants in RAA and AAA group is 84% and 69%. The American Society For Surgery Of The Hand (ASSH) grading of results of TAM for tendon repair categorizes an excellent result as 100%, good result as 75%-99%, fair result as 50%-74%, and poor result as < 50% of the TAM of the corresponding contralateral digit [9, 14].

In conclusion, the outcomes obtained from this study demonstrated that RAA or AAA provided a reliability of palmar arteriovenous anastomosis in the distal fingertip replantation, however, the outcomes obtained from RAA treatment was significantly superior to AAA treatment.

Disclosure of conflict of interest

None.

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