Survival Rate of Limb Replantation in Different Age Groups

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Abstract

Revascularization of damaged limbs/digits is technically feasible, but indications for surgical replantation remain controversial. The authors analyzed the survival rate of upper limb amputations and the associated factors in different age groups. They grouped 371 limb/digit amputees (average age, 44 years; range, 2–85 years) treated in their hospital during the past 10 years into three groups based on age (young, ≤ 15 years, $n = 12$; adult, 16–64 years, $n = 302$; elderly, ≥ 65 years, $n = 57$) and analyzed their injury type (extent of injury and stump status), operation method, presence of medical complications (Charlson comorbidity index), and survival rate. There were 168 replantations, and the overall replantation survival rate was 93%. The Charlson comorbidity index of the replantation patients was 0 in 124 cases; 1 in 32; 2 in 9; and 3 in 3, but it did not show any significant difference in survival rate after replantation. Eight elderly patients (14%) did not opt for replantation. Younger patients tended to undergo replantation, but they had lower success rates due to their severe injury status. The results of this study show that the survival rate of replantation in elderly patients is equal to that in adults. Stump evaluation is important for survival, but the presence of medical complications is not associated with the overall survival rate.

Keywords

- amputation
- replantation
- medical complication
- age

Introduction

Replantation represents a significant milestone in the development of hand trauma surgery.^{1,2} Survival rates between 70 and 90% after digital replantation have been reported, depending on the indication.³ Developments in microsurgery have led to excellent results in limb/digit replantation. However, although revascularization of damaged digits is technically feasible, indications for surgical replantation remain controversial because of disproportionate costs and benefits of replantations, shortening and closure of the amputation stump, low patient satisfaction levels, and incidence of post-replant problems such as cold intolerance.^{4–7}

Owing to improved health and safety standards in Japan, the Japanese have one of the longest life expectancies. Currently, replantation is performed in 29% of finger amputation cases,^{8,9}

and the number of older patients requiring replantation is increasing. Barzin et al¹⁰ reported that age alone should not be an absolute contraindication to finger replantation and that the patient's functional demands, type of injury, general state of health, and rehabilitative potential should be considered when deciding whether to perform replantation. The authors analyzed the survival rate of amputations and the associated factors in different age groups. They hypothesized that younger patients have a better survival rate for replantation.

Materials and Methods

There is no conflict of interest in this study. The authors retrospectively analyzed the data of 371 limb/digit amputees (average age, 44 years; range, 2–85 years) treated in their hospital over the past 10 years from April 2004 to December 2014 and

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divided them into three groups (young, ≤ 15 years, $n = 12$; adult, 16–64 years, $n = 302$; elderly, ≥ 65 years, $n = 57$). All study protocols were approved by the institutional review board of the hospital. The individual predictive factors investigated were amputation level, extent of injury (total or subtotal), type of injury, operation method (opted for replantation), survival (only for replantation), and the Charlson comorbidity index (presence of medical complications).¹¹ The authors classified the patients' amputation level, using the Tamai classification.¹² They also classified type of injury into five groups: sharp cut, local crushed, extensive crushed, avulsion, and degloving.¹³ They used the Charlson comorbidity index to categorize the comorbidities based on their International Classification of Diseases diagnosis codes. The clinical conditions and associated scores in the Charlson comorbidity index are as follows:

- 1 point: myocardial infarct, congestive heart failure, peripheral vascular disease, dementia, cerebrovascular disease, chronic lung disease, connective tissue disease, ulcer, chronic liver disease, diabetes
- 2 points: hemiplegia, moderate or severe kidney disease, diabetes with end-organ damage, tumor, leukemia, lymphoma
- 3 points: moderate or severe liver disease
- 6 points: malignant tumor, metastasis, AIDS

As for replantations, failure was defined as microvascular failure requiring revision amputation of the replanted finger or flap cover of the skeleton.⁷

Statistical Analysis

All variables were reported as means with ranges. The authors used the Kruskal-Wallis test to compare between two or more groups of an independent variable (age group, type of injury, amputation level, Charlson comorbidity index, and replantation survival) and the Mann-Whitney U test to compare two independent groups (extent of injury and survival of replantation). They set the level of significance at $p < 0.05$.

Results

Among the 371 patients, 168 underwent replantations; 170, stump plasties; 16, local flaps; and 17, composite grafts. Eleven patients did not opt for replantation. Significantly more patients did not opt for replantation in the elderly group (8 patients) and had medical complications (27 patients). Replantation was performed in 7, 137, and 24 young, adult, and elderly patients, respectively. The overall replantation survival rate was 93%. In replantation cases, the level of injury according to the Tamai classification was I in 10, II in 55, III in 48, IV in 27, and V in 11. There were 6 amputations on the level of the palm, 10 on the forearm, and 1 on the upper arm. The Charlson comorbidity index and the extent of injury did not show any significant difference in survival rate after replantation (► **Tables 1, 2**). The review of comorbidities demonstrated diabetes in 3.6% ($n = 6$) and hypertension in 7.7% ($n = 13$) patients. Younger patients tended to have replantation, but they had lower success rates, as their injury status was severe (► **Tables 3, 4**).

Table 1 Charlson comorbidity index versus survival

Survival	Charlson comorbidity index				Total
	0	1	2	> 3	
–	9	3	0	0	12
+	115	29	9	3	156
Total	124	32	9	3	168

$p = 0.761$.

Table 2 Status of amputation versus survival

Survival	Amputation		Total
	Total	Subtotal	
–	10	2	12
+	116	40	156
Total	126	42	168

$p = 0.732$.

Table 3 Age versus survival

Survival	Age group (y)			Total
	≤ 15	16–64	≥ 65	
–	3	8	1	12
+	4	129	23	156
Total	7	137	24	168

$p = 0.001$.

Discussion

This study showed that the survival rate of replantation is good even in elderly patients, including those with medical complications. The authors confirmed the patients' general condition before replantation, and age alone was associated with an increase in medical complications.^{14–16} Diseases that decrease peripheral circulation (such as atherosclerosis, diseases of the connective tissue, autoimmune diseases, diabetes mellitus) may reduce the survival rate and functional outcome, and thus constitute relative contraindications for replantation.¹⁷ Based on their results, the authors believe that replantation is possible even in patients with medical complications and that advanced age does not represent a contraindication for replantation. The decision to perform replantation should be assessed on a case-to-case basis and should not be based only on the age and general condition of the patient.

In addition, the survival rate after replantation was low in children. Replantation is slightly less successful in children than in adults, with only approximately 70% of digital replants surviving,¹⁸ which could be attributed to the smaller-caliber vessels present in children and surgeons tending to be more aggressive in trying to salvage amputations in children.¹⁹ In

Table 4 Injury type versus age

Age group (y)	Injury type					Total
	Sharp cut	Local crushed	Extensive crushed	Avulsion	Degloving	
< 15	1	3	0	2	1	7
16–64	19	70	32	7	9	137
> 65	6	13	3	2	0	24
Total	26	86	35	11	10	168

$p = 0.129$.

this study, most injuries in children were severe. Among the various factors influencing the outcome, the most important are type and level of injury, ischemia time, history of diabetes, age, sex, and smoking history.²⁰ Clean-cut amputations are a very good indication for replantation. Meanwhile, in extensively crushed and avulsion amputations, the survival rate and final functional outcome are poor. With modern microsurgical techniques, replantation is a useful technique in managing amputation in children, but stump evaluation is essential to achieve survival.²¹

The main limitation of this study was its retrospective nature. Furthermore, there was selection bias in the decision on surgical methods. The comorbid medical conditions of these patients were mostly mild. Several surgeons performed the replantation in this series, which introduced inherent variability in the treatment provided (operative techniques, decision for replantation). Replant survival was the authors' only outcome measure, and long-term functionality was not studied. Thus, a long-term follow-up study would be beneficial to patients with amputated digits in making informed decision.²²

In conclusion, the replantation rate in the elderly was found to be equal to that in adult patients, and the overall survival rate in young patients was not good because their stump status was usually worse. The authors recommend that the condition of the amputated stump be evaluated carefully when deciding to perform replantation.

Conflict of Interest

None.

References

- Kleinert HE, Serafin D, Kutz JE, Atasoy E. Reimplantation of amputated digits and hands. *Orthop Clin North Am* 1973;4(04): 957–967
- Komatsu S, Tamai S. Successful replantation of a completely cut-off thumb: case report. *Plast Reconstr Surg* 1968;42:374–377
- Dec W. A meta-analysis of success rates for digit replantation. *Tech Hand Up Extrem Surg* 2006;10(03):124–129
- Elliot D, Moiemens NS. Composite graft replacement of digital tips. 1. Before 1850 and after 1950. *J Hand Surg [Br]* 1997;22(03): 341–345
- Engel J, Luboshitz S, Jaffe B, Rotstein Z. To trim or replant: a matter of cost. *World J Surg* 1991;15(04):486–492
- Sears ED, Shin R, Prosser LA, Chung KC. Economic analysis of revision amputation and replantation treatment of finger amputation injuries. *Plast Reconstr Surg* 2014;133(04):827–840
- Breahna A, Siddiqui A, Fitzgerald O'Connor E, Iwuagwu FC. Replantation of digits: a review of predictive factors for survival. *J Hand Surg Eur Vol* 2016;41(07):753–757
- Epidemiology of traumatic finger amputation in Japan. Caloo. Available at <http://caloo.jp/dpc/code/160640>. Accessed June 23, 2014
- Nishizuka T, Shauver MJ, Zhong L, Chung KC, Hirata H. A Comparative Study of Attitudes Regarding Digit Replantation in the United States and Japan. *J Hand Surg Am* 2015;40(08):1646–1656, 1656.e1–1656.e3
- Barzin A, Hernandez-Boussard T, Lee GK, Curtin C. Adverse events following digital replantation in the elderly. *J Hand Surg Am* 2011; 36(05):870–874
- Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1987;40(05):373–383
- Tamai S. Twenty years' experience of limb replantation—review of 293 upper extremity replants. *J Hand Surg Am* 1982;7(06): 549–556
- Waikukul S, Sakarnkosol S, Vanadurongwan V, Un-nanuntana A. Results of 1018 digital replantations in 552 patients. *Injury* 2000; 31(01):33–40
- Ozkan O, Ozgentas HE, Islamoglu K, Boztug N, Bigat Z, Dikici MB. Experiences with microsurgical tissue transfers in elderly patients. *Microsurgery* 2005;25(05):390–395
- Howard MA, Cordeiro PG, Disa J, et al. Free tissue transfer in the elderly: incidence of perioperative complications following microsurgical reconstruction of 197 septuagenarians and octogenarians. *Plast Reconstr Surg* 2005;116(06):1659–1668, discussion 1669–1671
- Polanczyk CA, Marcantonio E, Goldman L, et al. Impact of age on perioperative complications and length of stay in patients undergoing noncardiac surgery. *Ann Intern Med* 2001;134(08):637–643
- Heistein JB, Cook PA. Factors affecting composite graft survival in digital tip amputations. *Ann Plast Surg* 2003;50(03):299–303
- Urbaniak JR. Replantation in children. In: Serafin D, Georgiade N, eds. *Pediatric Plastic Surgery*. St. Louis, MO: C.V. Mosby; 1984: 1168–1185
- Michalko KB, Bentz ML. Digital replantation in children. *Crit Care Med* 2002;30(11, Suppl):S444–S447
- Beris AE, Lykissas MG, Korompilias AV, Mitsionis GI, Vekris MD, Kostas-Agnantis IP. Digit and hand replantation. *Arch Orthop Trauma Surg* 2010;130(09):1141–1147
- Hattori Y, Doi K, Ikeda K, Estrella EP. A retrospective study of functional outcomes after successful replantation versus amputation closure for single fingertip amputations. *J Hand Surg Am* 2006;31(05):811–818
- Sebastian SJ, Chung KC. A systematic review of the outcomes of replantation of distal digital amputation. *Plast Reconstr Surg* 2011;128(03):723–737