

Immediate vs. delayed toe-to-thumb transfer: Is the infection rate greater?

Sofortige versus verzögert Zehentransplantation: erhöht sich die Infektionsrate?

Authors

Matteo Ornelli¹, Giovanni Ruocco¹, Juste Kaciulyte¹, Lara Lazzaro², Nicola Felici¹

Institutes

- 1 Azienda Ospedaliera San Camillo Forlanini, Unit of Reconstructive Surgery of the Limbs, Rom, Italy
- 2 Santa Maria della Misericordia, Udine AOU, Plastic Surgery, Udine, Italy

Schlüsselwörter

Infektion <Pathologie, Zehentransfer, Daumenrekonstruktion

Key words

Infection, toe transfer, thumb reconstruction

submitted 26.01.2019

accepted 05.03.2019

Bibliography

DOI <https://doi.org/10.1055/a-0874-2253>

Handchir Mikrochir Plast Chir 2019; 51: 434–439

© Georg Thieme Verlag KG Stuttgart · New York

ISSN 0722-1819

Corresponding address

MD Juste Kaciulyte

Azienda Ospedaliera San Camillo Forlanini Unit of Reconstructive Surgery of the Limbs

Circonvallazione Gianicolense, 87

00152 Rom - Italy

Tel.: 3407681680

Fax: 0655554591

E-Mail: justekc@gmail.com

ZUSAMMENFASSUNG

Einführung Im Falle eines Daumenverlustes stellt die Großzehe eine mögliche Entnahmestelle für die Rekonstruktion mit den Transplantationstechniken des freien Wrap-around-Lappens und der Trimmed-Toe-Methode dar. Frühe Rekonstruktionen scheinen das Risiko postoperativer Infektionen zu verringern, obwohl mehrere Studien unterschiedliche Infektionsraten der Empfängerstelle bei sofortiger Zehentransplantation zeigen. Die Autoren führten eine retrospektive Analyse ihrer Erfahrungen mit der Daumenrekonstruktion durch Transplantation der Großzehe durch und werteten die Ergebnisse aus, die bei sofortigen und verzögerten

Rekonstruktionen hinsichtlich des Auftretens von Infektionen erzielt wurden.

Patienten und Methodik Von 2000 bis 2017 wurden Patienten mit Schnitt-, Quetsch- und Avulsionsverletzungen am Daumen ausgewählt und 33 Zehentransplantationen durchgeführt. Die Patienten wurden in zwei Gruppen eingeteilt: In Gruppe A unterzogen sich die Patienten einer sofortigen Rekonstruktion, während in Gruppe B verzögerte Rekonstruktionen durchgeführt wurden. Beide Gruppen erhielten die gleiche antimikrobielle Prophylaxe. Die Zuverlässigkeit der sofortigen oder verzögerten Rekonstruktion wurde im Hinblick auf die Erhaltung von Gewebelappen, die Notwendigkeit einer sekundären Wundheilung und insbesondere der Infektionsrate verglichen.

Ergebnisse 29 männliche und 4 weibliche Patienten wurden behandelt. In beiden Gruppen wurden Zehentransplantationen durchgeführt: 8 Transplantationen mit freiem Wrap-Around-Lappen und 4 mit Trimmed-Toe-Technik in Gruppe A; 11 Transplantationen mit Wrap-Around-Technik und 10 mit Trimmed-Toe-Technik in Gruppe B. In keiner der beiden Gruppen kam es zum Verlust von Gewebelappen. Es wurden keine Infektionen an den transplantierten Zehen festgestellt. Diskussion: In Bezug auf Zehentransplantationen weist die Literatur ein breites Spektrum von Infektionsraten der Empfängerstellen auf. Die Autoren verglichen ihre Ergebnisse in Bezug auf die Infektionsrate zwischen der sofortigen Rekonstruktion, Gruppe A, und der verzögerten Rekonstruktion, Gruppe B. Die transplantierten Zehen wiesen keine Anzeichen von Infektionen auf.

Schlussfolgerung Die sofortige Zehentransplantation zeigte die gleichen Erfolgsraten wie die verzögerte. Zwischen den beiden Gruppen wurde kein statistisch signifikanter Unterschied im Infektionsrisiko festgestellt. Die Ergebnisse zeigten, dass die sofortige Rekonstruktion genauso sicher und zuverlässig war wie die verzögerte.

ABSTRACT

Background After loss of a thumb, the big toe is a possible donor site for reconstruction with wrap-around free flap and trimmed-toe transfer techniques. Early reconstructions seem to reduce the risk of post-operative infections, despite several studies that show different infection rates of the recipient site in immediate toe-to-hand transfer. The authors carried out a retrospective analysis of their experience in thumb reconstruction with big toe transfer and evaluated the results achieved

with both immediate and delayed reconstructions in terms of infection occurrence.

Patients and Methods From 2000 to 2017, patients who presented cut, crush and avulsion injuries in the thumb were selected and 33 toe-to-thumb transfers were performed. Patients were divided into two groups: in group A, patients underwent immediate reconstruction, while in group B delayed reconstructions were performed. The two groups received identical antimicrobial prophylaxis. Reliability of the immediate or delayed reconstruction was compared in terms of flap survival, requirement for a secondary intention healing and, in particular, rate of infection.

Results 29 male and 4 female patients were treated. Toe-to-thumb transfers were performed in both groups: in group A,

8 wrap-around free flaps and 4 trimmed toe transfers; in group B, 11 wrap-around and 10 trimmed toe transfers. No flap loss occurred in either groups. No cases of infection were detected in the transferred toes.

Conclusion For toe-to-thumb transfer, there are published reports of a wide range of infection rates of the recipient sites. The authors compared their results in terms of infection rate between immediate reconstruction, group A, and delayed reconstruction, group B. Immediate toe-to-thumb transfer showed equal success rates to delayed transfer. No statistically significant difference in risk of infection between the two groups was found. Results showed that the immediate reconstruction was as safe and reliable as the delayed one.

Introduction

The thumb is unique for its movements of opposition and circumduction and provides almost 40% of hand function. Traumatic loss of the thumb is considered one of the most devastating impacts on hand function and every possible effort has to be made to reconstruct the lost thumb following trauma [1]. The great and the second toes are considered as possible donor sites for thumb reconstruction; however, the great toe is favored for its major grip strength, even if it presents some drawbacks due to its anatomic characteristics and increased donor-site morbidity. Wrap-around [2, 3] and trimmed-toe-transfers [4, 5] are used to overcome these problems. Whatever technique is chosen, the best timing to perform is still controversial. On the one hand, an early reconstruction allows a reduction in hospitalization and recovery time. On the other hand, a better definition of the injury zone is achieved with a delayed reconstruction that, according to some authors, seems to optimize the success of subsequent toe-to-hand transfer [6]. Furthermore, the terminology regarding the definition of reconstructive timing is very confusing in literature: “emergency,” “early,” and “delay” are terms used to identify the timing of the free flap, but they are all based on arbitrary definitions because different authors use various criteria. According to Lister et al [7], the reconstruction was considered performed in emergency when wound coverage was achieved within 24 hours of injury. Conversely, in 1986, Godina [8] described the time of reconstruction as “early” when performed in less than 72 hours since injury, “delayed” when it occurred between 72 hours and 3 months and “late” if carried out after more than 3 months. Delayed reconstructions are frequently performed, but defer rehabilitation and functional recovery and enhance the risk of infections, including osteomyelitis [9]. Early reconstructions seem to reduce the risk of post-operative infections, free-flap failure, average hospitalization and healing time [10]. These outcomes regard, in particular, free flaps for lower limbs coverage, but they are not completely suitable for toe-to-hand-transfer. Indeed, several studies showed different infection rates of the recipient site in immediate toe-to-hand transfers [11].

The authors carried out a retrospective analysis on their experience in thumb reconstruction with the first toe transfer, evaluat-

ed the results achieved in both immediate and delayed reconstructions in terms of infection occurrence.

Patients and methods

From 2000 to 2017, toe-to-thumb transfers were performed for avulsion or crush trauma on 33 patients: 29 males and 4 females, aged between 17 and 52 years.

Only cut, crush and avulsion injuries were included in the study; degloving injuries were excluded.

Patients were divided into two groups. Group A consisted of 12 patients with thumb amputation treated within 48 hours after injury with toe transfer, and patients with failure of primary replantation attempts who underwent toe transfer at the same time of removal of the necrotic thumb (► Fig. 1). Group B consisted of 21 patients with delayed reconstruction. This group included patients who underwent first ray reconstruction with toe transfer after definitive soft tissue healing of amputation stump (► Fig. 2).

In order to compare homogeneous groups of patients, the authors included in the study only patients who underwent toe-to-thumb transfer, excluding those treated with other reconstruction techniques (i. e. pollicization).

Informed consent was obtained from all the patients. Patients understood and accepted the risks of operative failure, donor site morbidity and functional limitations of the transferred toe.

Toe-to-thumb transfer was performed with two techniques: wrap-around free flap and trimmed toe-to-thumb transfer. In Group A an immediate extensive debridement with removal of all potentially necrotic tissues of the amputated stump was performed before starting transfer harvesting; it was then washed with an antiseptic solution (Sodium Hypochlorite 0.06% solution). Osteosynthesis was achieved by Kirschner wires pinning in both groups. Antimicrobial prophylaxis protocol was identical in the two groups: intravenous cefazolin 3 × 1 g (if patient’s weight < 80 kg) or 3 × 2 g (if patient’s weight > 80 kg) was administered from presentation in the emergency room, up to 24 hours after surgery.

In the decision taking, the authors referred to the classification of the level of thumb amputation and opted for Merle classifica-



► **Fig. 1** a Failure of Thumb replantation and preoperative marks for recipient vessels. b Planning for trimmed great toe. c Control at 1 year

tion [12] (1991) which identifies 7 levels. Patients classified at levels from 1 to 4 were included in the present study.

Authors are strongly convinced of the advantages of the immediate toe-to-thumb transfer. For this reason, this option has been proposed to all the patients with acute amputative injury of the thumb with no indication for replantation. Immediate toe transfer was also proposed to all the patients with failure of thumb replantation at the moment of the removal of the necrotic stump. Patients of Group B were previously treated in other hospitals and they arrived to Authors' center after soft tissue healing of the amputation stump.

The reliability of the immediate or delayed reconstruction in case of thumb amputation is based on the analysis of patients' records for flap survival, requirement of a secondary procedure and, in particular, of rate of infection.

Results

In this retrospective study, 29 male patients and 4 female patients were treated; in Group A, "immediate reconstruction", we performed wrap-around in 8 patients and trimmed toe transfer in

4 cases; in Group B, "delayed reconstruction", we performed 11 wrap-around and 10 trimmed toe transfers.

No flap loss occurred in both groups. Eight surgical wound dehiscences occurred at donor site, all healed without further surgery.

No patient was hospitalized again for complications and no antibiotic therapy was needed for post-operative infection occurred at recipient site.

Secondary procedures were performed in 2 cases in group A and in 5 cases in group B for cosmetic refinements at more than 1 year after transfer.

No cases of infection were detected in the transferred toes.

One case of wound infection with wound dehiscence occurred at the donor site in a Group B trimmed toe patient (► **Table 1**).

It was resolved by a second intention healing with Hydrofiber Technology dressing, a soft and absorbable material containing ionic silver, that transforms into a gel on contact with wound fluid (► **Fig. 3**).



► **Fig. 2** a Traumatic amputation of thumb at level 1. b Control at 11 years

► **Table 1** Summary of results.

	Group A Immediate reconstruction	Group B Delayed reconstruction	TOTAL
N. patients	12	21	33
Male/Female	11/1	18/3	29/4
Wrap-around technique	8	11	19
Trimmed-toe- transfer technique	4	10	14
Flap failure	0	0	0
Secondary procedure	2	5	7
Infection recipient site	0	0	0
Infection donor site	0	1	1



► **Fig. 3** a Donor site skin necrosis. b Control after 12 weeks

Discussion

Surgical site infection is the most common complication that surgeons have to face [13]. In order to prevent this problem, prophylactic antibiotics are widely applied, even if their selection, timing and duration of administration represent topics of many debates in literature [14].

Antibiotic resistance is spreading all over the world and its threat has been announced by The World Health Organization (WHO) [15]. For this reason, specific antimicrobial regimens are suggested by different guidelines, applied in several hospitals in various countries [16].

Indeed, data extracted from literature about toe-to-thumb transfer are similar in terms of vascular complications and survival rate, but show differences in infection rate of the recipient site.

Various reports registered different infection rates: from 6.5% for immediate procedure against 0.7% for delayed one [6], to 4% vs 3.1% as Woo SH [17] et al study showed, to 0.5% in a further study by the same authors [18] and 1 out of 6 cases reported by Ray EC [19].

The terminology regarding the definition of reconstruction timing reported in literature is also quite confusing. The authors considered immediate reconstruction when toe-to-hand transplantation was performed within 48 hours after injury and, in case of failed replantation at the necrotic thumb removal, while for delayed transfer they referred to the first ray reconstruction performed after the definitive soft tissue healing of the amputation stump.

The authors compared their results in terms of infection rate between the two groups. No infection has been reported in the transferred toes; one case of donor site infection with wound dehiscence was detected in a Group B trimmed toe. However, this evidence was not statistically significant.

Safety of immediate microsurgical reconstruction has been widely discussed, in terms of potential failure and infection risks.

Indeed, a recent metaanalysis [20] investigated on the timing for microsurgical reconstruction of lower limbs. Results obtained in early and delayed surgeries were compared and there was no evidence of worse outcomes in early reconstructions.

On the basis of the authors' experience, immediate and delayed toe-to-thumb reconstructions did not show significant differences in terms of infection.

Discrepancies between our results and a higher infection rate reported by other studies, such as the one by Yim and Wei [11], can be explained by the different timing of the immediate procedures performed up to 7 days after injury, and that even multi-digital amputations were included in the study.

Nowadays, controversies about timing are still alive. In the authors' opinion, the immediate procedure has the advantage of being more practical, especially during dissection of the neurovascular pedicle, due to the absence of scarring and fibrotic adhesions; it allows to avoid hand extensive dissection for the presence of an open wound and, obviously, minimize the duration of recovery and rehabilitation.

In most cases, an immediate reconstruction can be safely achieved and is strongly recommended [21].

In Authors' practice also, immediate thumb reconstruction in non replantable cases is the preferred approach. One of the main problems is represented by patient's compliance and psycholog-

ical acceptance, because the patient is asked to take an important decision in a few hours after a major injury. For this reason, an exhaustive informed consent is mandatory before surgery.

However, this is not a mandatory indication in every case of thumb amputation and does not mean that the delayed procedure should be abandoned. Indeed, a better definition of the injury zone is achieved with a delayed reconstruction that, according to some authors, seems to optimize the success of subsequent toe-to-hand transplantation [11].

CONCLUSION

Data reported in literature about infection rate in toe-to-thumb transfer are different and the procedure timing is also controversial. Even its definition is still a topic of debate. The authors adopted the terms "immediate" and "delayed" reconstruction and compared the results of their experience after performing 33 wrap-around and trimmed-toe transfers. Immediate toe transfer showed equal success rates as the delayed one in terms of survival, complications, and secondary revisions. No statistically significant differences in risk of infection among the two groups have been reported. Results of the present study showed that the immediate reconstruction was as safe and reliable as the delayed one; when possible, it should be considered in the decision making on thumb amputations management.

According to the data reported in literature and the outcomes of this study, the authors assume that shorter time between injury and extensive debridement associated to early toe-to-thumb transfer are related to a minor exposure of the amputation stump and, consequently, to lower risks of infection.

Conflict of interest

The authors declare that they have no conflict of interest.

Authors



Dr. Nicola Felici was born in 1966. Since 2016, he is the Director of the Division of Reconstructive Surgery of Limbs in San Camillo Hospital, Rome.

References

- [1] Kempny T, Paroulek J, Marik V et al. Further developments in the twisted-toe technique for isolated thumb reconstruction: our method of choice. *Plast Reconstr Surg* 2013 Jun; 131(6): 871e-879e
- [2] Morrison WA, O'Brien BM, MacLeod AM. Thumb reconstruction with a free neurovascular wrap around flap from the big toe. *J Hand Surg Am* 1980; 5: 575-583
- [3] Upton J, Mutimer K. A modification of the great-toe transfer for thumb reconstruction. *Plast Reconstr Surg* 1988; 82: 535-538
- [4] Foucher G, Binhammer P. Plea to save the great toe in total thumb reconstruction. *Microsurgery* 1995; 16: 373-376
- [5] Tsai TM, Aziz W. Toe-to-thumb transfer: A new technique. *Plast Reconstr Surg* 1991; 88: 149-153
- [6] Yim KK, Wei FC, Lin CH. A comparison between primary and secondary toe-to-hand transplantation. *Plast Reconstr Surg* 2004 Jul; 114(1): 107-112
- [7] Lister, G., and Scheker, L. Emergency free flaps to the upper extremity. *J. Hand Surg. (Am.)* 13: 22, 1988
- [8] Godina, M. Early microsurgical reconstruction of complex trauma of the extremities. *Plast. Reconstr. Surg* 78: 285, 1986
- [9] Zhan Y, Fu G, Zhou X. Emergency repair of upper extremity large soft tissue and vascular injuries with flow-through anterolateral thigh free flaps. *Int J Surg* 2017 Dec; 48: 53-58
- [10] Haykal S, Roy M1, Patel A. Meta-analysis of Timing for Microsurgical Free-Flap Reconstruction for Lower Limb Injury: Evaluation of the Godina Principles. *J Reconstr Microsurg* 2018 May; 34(4): 277-292
- [11] Yim KK, Wei FC, Lin CH. A comparison between primary and secondary toe-to-hand transplantation. *Plast Reconstr Surg* 2004 Jul; 114(1): 107-112
- [12] Merle M. A critical study of thumb reconstruction by second toe transfer. *Ann Chir Main Memb Super* 1991, 10: 517-522
- [13] Fletcher N, Sofianos D, Berkes MB et al. Prevention of perioperative infection. *J Bone Joint Surg Am* 2007 Jul; 89(7): 1605-1618
- [14] Bryson DJ, Morris DL, Shivji FS, et al. Antibiotic prophylaxis in orthopaedic surgery: difficult decisions in an era of evolving antibiotic resistance. *Bone Joint J* 2016 Aug; 98-B(8): 1014-1019
- [15] Antimicrobial resistance: global report on surveillance 2014. <http://www.who.int/drugresistance/documents/surveillancereport/en/> (date last accessed 19 December 2018)
- [16] Chang Y, Kennedy SA, Bhandari M et al. Effects of Antibiotic Prophylaxis in Patients with Open Fracture of the Extremities: A Systematic Review of Randomized Controlled Trials. *JBJS Rev* 2015 Jun 9; 3(6)
- [17] Woo SH, Kim JS, Seul JH. Immediate Toe-to-Hand Transfer in Acute Hand Injuries: Overall Results, Compared with Results for Elective Cases. *Plast. Reconstr. Surg* 113: 882, 2004
- [18] Woo SH, Lee GJ, Kim KC et al. Immediate partial great toe transfer for the reconstruction of composite defects of the distal thumb. *Plast Reconstr Surg.* 2006 May; 117(6): 1906-1915
- [19] Ray CE, Sherman R, Stevanovic M. Immediate Reconstruction of a Non-replantable Thumb Amputation by Great Toe Transfer. *Plast Reconstr Surg* 2009 Jan; 123(1): 259-267
- [20] Haykal S, Roy M, Patel A. Meta-analysis of Timing for Microsurgical Free-Flap Reconstruction for Lower Limb Injury: Evaluation of the Godina Principles. *J Reconstr Microsurg* 2018 May; 34(4): 277-292
- [21] Woo SH, Yoo MJ; Paeng JW. Recent advances in Immediate Toe-to-Hand Transfer. *The Journal of Hand Surgert (Asian Volume)* 2016; 21(3): 292-299