Differences in treatment of digital amputation injuries based on community transfer versus tertiary initial presentation

Benjamin Amis · Jeffrey Friedrich

Published online: 13 July 2012
© American Association for Hand Surgery 2012

Abstract

Background The purpose of this paper is to compare a group of patients with upper extremity amputation injuries who presented to a tertiary referral center without having been previously seen at another hospital versus a group of patients who was transferred from another facility. We hypothesize that transferred patients will generally undergo more complex treatments, that some transferred patients will be treated in the ER with simple treatments (thereby perhaps not requiring transfer), and that transferred patients will be less likely to have insurance coverage.

Methods All patients who presented to our ER from January 1, 2007 to December 31, 2008 with the classification of hand and finger amputation were included. Data collected included whether or not the patient was transferred from another institution, age, mechanism of injury, partial versus total amputation, location treated, transportation method, general treatment classification, type of insurance, and month of presentation.

Results No statistical difference was found between patients who were transferred versus those who were not with respect to age, sex, mechanism, whether the amputation was partial versus complete, or insurance coverage. Statistical differences were noted between the subset of patients who

was transferred versus those who were not with respect to treatment location, method of transportation, and treatment. **Conclusions** Patients transferred to our institution required significantly more complex treatments and were significantly more likely to be treated in the operating room. A small but significant group of patients was treated in the ER or required relatively simple treatments after transfer. Our hypothesis that a higher percentage of patients transferred to our institution would have less insurance coverage was not supported by the data. Tertiary centers can expect to continue receiving a steady stream of amputation referrals.

Keywords Hand amputation · Digital amputation · Transfer · Treatment

Background

Digital amputations are common and often disabling injuries. Improvements in magnification technologies, instrumentation, suture material, and techniques, as well as careful patient selection, have led to success rates for digital replantation of greater than 90 % in both adults and children in some series [3, 14]. Despite the many successes in replantation over the years, the decision to replant remains a difficult one. Many disparate factors, such as extent of damage to the amputated digit, chance of survival of the digit, possible advantages of revision, functional outcome, and morbidity to the patient, must be considered [5].

However, not all hospitals are properly staffed and equipped to perform more specialized procedures, and many patients must be transferred to a tertiary referral center. A system of air and ground transport to support a regional trauma center model has been developed nationwide [8, 10]. Transferring facilities may cite a lack of resources, medical necessity, or the need for more specialized care as

B. Amis (✉)
Department of Orthopaedics and Sports Medicine,
Harborview Medical Center, University of Washington,
Box 359798, 325 Ninth Ave.,
Seattle, WA 98104, USA
e-mail: amisb@u.washington.edu

J. Friedrich
Division of Plastic Surgery, Harborview Medical Center,
University of Washington,
8th Floor, East Hospital, Box 359835, 325 Ninth Ave.,
Seattle, WA 98104, USA
e-mail: jfriedri@u.washington.edu

the primary reasons for transfer. While clear benefits have been demonstrated for the most severely injured patients, some reviews document a significant “over-triage” of patients by utilization of air transport for a variety of injuries, no improvement of outcomes in patients transported via air, and that a portion of patients transferred via air with digital amputations do not undergo replantation [1, 2, 9, 12]. Other recent studies have suggested that payer status, not medical necessity, may be the driving factor in some transfers [7, 11].

The overall survival rate for digital replantation has been well documented as have the many factors that may contribute to an improved functional outcome. However, less attention has been paid to the initial triage, transfer, and treatment of patients with digital amputations. The purpose of this paper is to compare a group of patients with partial and complete digital amputation injuries who initially presented to a tertiary referral center emergency room (ER) versus a group that was transferred from the community. We hypothesize that transferred patients will generally undergo more complex treatments, that some transferred patients will be treated in the ER with simple treatments (thereby perhaps not requiring transfer), and that transferred patients will be less likely to have insurance coverage.

Methods

This study was conducted with approval of our institution’s Institutional Review Board. This tertiary medical center is the sole level 1 trauma center for a 4-state catchment area. The tertiary referral center operates a transfer center through which all transfers are arranged and approved. A separate database also documents all patients who present to the ER, whether transferred or not, with traumatic injuries. All patients who presented to our ER (via transfer or for initial evaluation) from January 1, 2007 to December 31, 2008 with the classification of hand and finger amputation (International Classification of Diseases, ninth revision (ICD-9) codes 885.X, 886.X, and 887.X) were included in the study. We did not include ICD-9 codes for hand and digital lacerations and other minor injuries in order to capture only more serious injuries that would merit comparison with a transferred group. Data collected included whether or not the patient was transferred from another institution, age, mechanism of injury, partial versus complete amputation, location treated (ER versus operating room (OR)), transportation method, general treatment classification, and payer status. For the purposes of this study, treatment classification was assigned along a very general criterion, with replantation being the most complex treatment rendered. This was followed in decreasing complexity by revascularization, complex repair (involving two or more of bone, tendon, nerve,

and vessel), simple repair (involving only one of bone, tendon, nerve, and vessel), revision amputation, or debridement. Only one treatment class was assigned to each case, and the most complex treatment rendered determined the classification. The patients that were transferred from another hospital versus those whose initial presentation was at our institution were separated into subsets. The *t* test was used to compare groups of continuous variables and the chi-squared test was used to compare groups of categorical variables. A *p* value of less than 0.05 was considered statistically significant.

Results

During a 2-year period encompassing 2007 and 2008, 356 patients presented either initially or after transfer from another hospital to our institution with hand or digital amputation injuries. Just under half (47.5 %) of the patients seen in the emergency department were initially evaluated at another hospital and transferred to our institution. No statistical difference was found between patients who were transferred versus those who were not with respect to age, sex, mechanism, whether the amputation was partial versus complete, or insurance coverage. The average age of both groups was 40.5 years and 88.2 % were male. The most common mechanism of injury in both groups was power saw, followed by crush, avulsion, sharp cut, and other. Statistical differences were noted between the subset of patients who were transferred versus those who were not with respect to treatment location, method of transportation, and final treatment. In comparison to patients whose initial presentation was at our hospital, patients who were transferred to our institution were nearly twice as likely to be treated in the OR (84.6 versus 40.1 %), much more likely to be transported via air (46.2 versus 3.7 %), and more likely to undergo a complex treatment (replantation (18.3 %), revascularization (16.0 %), complex repair (13.6 %), or simple repair (18.9 %)). Patients who were not transferred from an outside hospital were more likely to be treated in the emergency department (ED) (59.9 %), transported via an ambulance (61.5 %) or private vehicle (34.8 %), and treated with a revision amputation (44.9 %) or debridement (31.0 %) (Table 1). No statistical differences were found regarding payer status between the two groups of patients, with the majority of insurance coverage provided by either worker’s compensation or private insurance (Table 2).

Discussion

One recent study analyzing the epidemiology of upper extremity replantations found that over 1,361 replantation

Table 1 Comparison of patients whose initial presentation was at our hospital and patients who were transferred to our institution regarding treatment location, transportation, and treatment

	Transferred		Non-transferred		P value
Treatment location					<0.0001
OR	143	84.6 %	75	40.1 %	
ER	26	15.4 %	112	59.9 %	
Transportation					<0.0001
Ambulance (ground)	74	43.8 %	115	61.5 %	
Air	78	46.2 %	7	3.7 %	
Private auto	17	10.1 %	65	34.8 %	
Treatment					<0.0001
Debridement	13	7.7 %	58	31.0 %	
Revision	43	25.4 %	84	44.9 %	
Simple repair	32	18.9 %	17	9.1 %	
Complex repair	23	13.6 %	15	8.0 %	
Revascularization	27	16.0 %	8	4.3 %	
Replantation	31	18.3 %	5	2.7 %	

procedures were performed over three non-consecutive years. This study concluded that replantations are more likely to occur on younger patients at large, urban teaching institutions and that these patients have longer, more expensive hospital stays than patients with upper extremity amputations who do not undergo replantation [6]. Despite the many advances in digital replantation and high success rates, treatment algorithms remain difficult, especially for patients who first present at hospitals that do not have the resources to provide complex treatments such as revascularization or replantation.

Our study's primary data points document the differences in the complexity of treatment of patients who were transferred to our institution versus those whose initial presentation was in our emergency room. Our hypothesis that patients who were transferred would undergo more complex treatments was affirmed. Patients who were transferred were treated over twice as frequently in the operating room (84.6 versus 40.1 %) and with a significantly greater number of replantation and revascularization procedures (34.3 versus 7 %). The transferred group procedures included far more repairs of bones, tendon, nerves, and vessels as compared to the non-transferred group (32.5 versus 17.1 %). Non-

transferred patients procedures included significantly more revision amputations and debridements in comparison to the transferred group (75.9 versus 33.1 %). Clearly, at our institution, transferred patients received a more complex level of care than those who were not transferred from another institution.

A more nuanced question that our paper attempted to address was to what degree over-triage exists for patients transferred with digital amputation injuries. While the data presented above indicate that transferred patients generally underwent significantly more complex treatments, there remains a subgroup of transferred patients who were treated in the ER (15.4 %) and with relatively facile treatments of debridement or revision amputation (33.1 %). We believe that at least a portion of these patients represent over-triage and further study is needed to better identify patients who do not necessitate transfer and how best to allocate resources in a health care system with finite resources. Anecdotally, we have found that treating some transferred patients in the OR is sometimes an attempt to provide good “customer service” for a patient that has traveled a long distance and endured a long wait prior to definitive injury treatment. Given this,

Table 2 Comparison between transferred and non-transferred groups regarding payer status

	Transferred		Non-transferred		P value
Insurance					0.12
Worker's compensation	52	30.8 %	77	41.2 %	
Private	66	39.1 %	54	28.9 %	
None	28	16.6 %	38	20.3 %	
Medicare	12	7.1 %	11	5.9 %	
Medicaid	9	5.3 %	4	2.1 %	
Low Income allowance	2	1.2 %	3	1.6 %	

some of the patients who were transferred and treated in the OR may have been treated in the ED had they not been transferred from another facility.

One aspect of the care of amputated digits germane to this discussion is the limited number of hospitals and fellowship-trained hand surgeons performing digital replantation. In one epidemiological study of finger replantation in USA, only 136 of 904 hospitals included in the Healthcare Cost and Utilization Project performed replantations in the study period and only 2 % of the hospitals performed more than ten replants [4]. The reasons for these limited replantation resources are complex; however, some clues can be found in a recent survey study of hand surgeons. A significant portion (just over 40 %) of fellowship-trained hand surgeons does not perform digital replantations. These surgeons cited busy elective schedules, inadequate confidence in their microsurgical skills, and disappointing results as reasons they do not perform these procedures. However, 30 % would reconsider if reimbursement was greater [13]. These studies point toward the limited resources for replantation and help demonstrate that tertiary centers can expect to continue receiving a steady stream of amputation referrals.

Our hypothesis that a higher percentage of patients transferred to our institution would have less insurance coverage, based on previous studies [7, 11] and our own intuition, was not supported by the data. No statistical difference was found between the transferred and non-transferred groups, with the majority of patients being covered by either worker's compensation or private insurance in both groups. At some tertiary referral centers, there is some concern that the primary reason for some transfers is that the patient is not funded. Our study indicates that at least at our institution, "dumping" does not appear to be a major problem in patients with digital amputation injuries.

Our study has several limitations. The first is that our institution has a transfer center. Not all hospitals are staffed with a full-time transfer center to facilitate triage of patients. Whether a transfer center results in increased, decreased, or no change in overall rates and types of patients transferred remains unclear. This factor thereby limits the generalizability of this data to institutions without transfer centers. Additionally, our study was also limited by our review process, which captured all patients with the diagnosis of digital and hand amputations and did not address patients with lesser hand injuries. Had we included ICD-9 codes for lesser hand injuries, we may have found a different trend in the rate of transfer and subsequent treatments of patients with lesser injuries. Furthermore, all of the data were collected via retrospective chart reviews and were subject to the inherent

disadvantages of this process including but not limited to a reliance on the accuracy of the written record, missing data, difficulty of accessing some desired data points, and lack of randomization and blinding.

Acknowledgments The authors thank Jin Wang for her assistance with statistical calculations.

Conflict of interest No grants or other financial support was used in the writing of this manuscript.

References

1. Boyd C, Corse K, Campbell R. Emergency interhospital transport of the major trauma patient: air versus ground. *J Trauma*. 1989;29(6):789–93. discussion 93–4. PubMed PMID: 2738976.
2. Chappell V, Mileski W, Wolf S, Gore D. Impact of discontinuing a hospital-based air ambulance service on trauma patient outcomes. *J Trauma*. 2002;52(3):486–91.
3. Cheng G, Pan D, Yang Z, Fang G, Gong X. Digital replantation in children. *Ann Plast Surg*. 1985;15(4):325–31.
4. Chung K, Kowalski C, Walters M. Finger replantation in the United States: rates and resource use from the 1996 healthcare cost and utilization project. *J Hand Surg Am*. 2000;25(6):1038–42. doi:10.1053/jhsu.2000.16356.
5. Dec W. A meta-analysis of success rates for digit replantation. *Tech Hand Upper Extrem Surg*. 2006;10(3):124–9. doi:10.1097/01.bth.0000225005.64605.17.
6. Friedrich JB, Poppler LH, Mack CD, Rivara FP, Levin LS, Klein MB. Epidemiology of upper extremity replantation surgery in the United States. *J Hand Surg Am*. 2011;36(11):1835–40. doi:10.1016/j.jhsa.2011.08.002.
7. Koval KJ, Tingey CW, Spratt KF. Are patients being transferred to level-I trauma centers for reasons other than medical necessity? *J Bone Joint Surg Am*. 2006;88(10):2124–32. doi:10.2106/JBJS.F.00245.
8. MacKenzie EJ, Rivara FP, Jurkovich GJ, Nathens AB, Frey KP, Egleston BL, et al. A national evaluation of the effect of trauma-center care on mortality. *N Engl J Med*. 2006;354(4):366–78. doi:10.1056/NEJMSa052049.
9. Mann N, Pinkney K, Price D, Rowland D, Arthur M, Hedges J, et al. Injury mortality following the loss of air medical support for rural interhospital transport. *Acad Emerg Med*. 2002;9(7):694–8.
10. Nathens AB, Jurkovich GJ, Rivara FP, Maier RV. Effectiveness of state trauma systems in reducing injury-related mortality: a national evaluation. *J Trauma*. 2000;48(1):25–30. discussion 1. PubMed PMID: 10647561.
11. Nathens AB, Maier RV, Copass MK, Jurkovich GJ. Payer status: the unspoken triage criterion. *J Trauma*. 2001;50(5):776–83.
12. Ozer K, Kramer W, Gillani S, Williams A, Ipaktchi K, Smith W. Emergency air transport for finger amputations at a level I trauma center. *J Hand Surg*. 34(7, Supplement 1):1.
13. Payatakes A, Zagoreos N, Fedorcik G, Ruch D, Levin L. Current practice of microsurgery by members of the American Society for Surgery of the Hand. *J Hand Surg Am*. 2007;32(4):541–7. doi:10.1016/j.jhsa.2006.12.006.
14. Waikukul S, Sakkarnkosol S, Vanadurongwan V, Un-nanuntana A. Results of 1018 digital replantations in 552 patients. *Injury*. 2000;31(1):33–40.