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Comparing Plastic Surgeon Versus Orthopedic Surgeon Outcomes Following Distal Upper Extremity Amputations: A Study of the National Surgical Quality Improvement Program (NSQIP) Database

La comparaison des résultats d'amputations distales des extrémités supérieures exécutées par des plasticiens ou des chirurgiens orthopédiques : étude de la base de données du Programme national d'amélioration de la qualité des soins chirurgicaux (NSQIP)

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Abstract

Background: Both plastic and orthopedic surgeons manage care for urgent/emergent hand conditions. It is unclear if surgeon specialty affects patient outcomes of these cases. The purpose of this study was to evaluate differences in 30-day perioperative outcomes between plastic and orthopedic surgeons following distal upper extremity amputations. **Methods:** Patients who underwent distal upper extremity amputations between 2005 and 2016 were identified within the National Surgical Quality Improvement Program (NSQIP) database using *Current Procedural Terminology* (*CPT*) codes. Differences in operative procedures, patient demographics, patient comorbidities, and 30-day perioperative complications were compared between orthopedic and plastic surgeons by univariate analysis. A Bonferroni correction was applied to account for multiple comparisons of complications. **Results:** A total of 1583 cases met inclusion criteria. Orthopedic surgeons performed 981 cases (62.0%) and plastic surgeons performed 602 cases (38.0%). Finger amputations comprised the majority of procedures for both orthopedic and plastic surgeons (95.5% and 94.4%, respectively). Orthopedic surgeons had a lower operative time (41.7 $\pm$ 36.2 minutes vs 47.1 $\pm$ 40.9 minutes, $P = .008$). There were no differences in proportion of emergency surgery, inpatients, or wound class. There were no differences in age, gender, or body mass index. The most common indications for amputation were trauma, gangrene, and osteomyelitis. There were no differences between surgical specialties in 18 30-day perioperative complications assessed, including death, reoperation, surgical site infection, or wound dehiscence. **Conclusions:** Plastic and orthopedic surgeons achieved equivalent outcomes comparing 30-day perioperative complications following upper extremity amputations. These results support that both orthopedic and plastic surgeons provide similar quality distal upper extremity amputation care.

Résumé

Historique : Tant les plasticiens que les chirurgiens orthopédiques prennent en charge les cas d'affections urgentes ou d'extrême urgence touchant les mains. On ne sait pas si la spécialité chirurgicale a une incidence sur le pronostic des patients atteints de ces

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problèmes. La présente étude visait à évaluer les différences entre les résultats périopératoires des plasticiens et des chirurgiens orthopédiques 30 jours après des amputations distales des extrémités supérieures. **Méthodologie :** Les patients qui ont subi une amputation distale des extrémités supérieures entre 2005 et 2016 ont été extraits de la base de données du Programme national d'amélioration de la qualité des soins chirurgicaux (NSQIP) à l'aide des codes du Catalogue des actes médicaux (CPT). Au moyen d'une analyse univariée, les chercheurs ont comparé les différences entre les interventions opératoires effectuées par les chirurgiens orthopédiques et les plasticiens, les caractéristiques démographiques des patients, leurs autres affections et leurs complications périopératoires au bout de 30 jours. Ils ont utilisé une correction de Bonferroni pour tenir compte de multiples comparaisons entre les complications. **Résultats :** Au total, 1 583 cas respectaient les critères d'inclusion. Les chirurgiens orthopédiques ont opéré 981 cas (62,0 %) et les plasticiens, 602 cas (38,0 %). Les amputations des doigts représentaient la majorité des interventions effectuées par les chirurgiens orthopédiques et les plasticiens (95,5 % et 94,4 % respectivement). Les opérations pratiquées par les chirurgiens orthopédiques étaient plus courtes (41,7 $\pm$ 36,2 minutes par rapport à 47,1 $\pm$ 40,9 minutes, $p = 0{,}008$). Il n'y avait pas de différence quant à la proportion d'opérations d'urgence, de patients hospitalisés ou de catégories de plaies ni pour ce qui est de l'âge, du genre et de l'indice de masse corporelle. Les principales indications d'amputation étaient des traumatismes, la gangrène et l'ostéomyélite. Il n'y avait pas de différence entre les spécialités chirurgicales lors de l'évaluation des complications périopératoires au bout de 18 et 30 jours, y compris les décès, les réopérations, l'infection au foyer des infections et la déhiscence des plaies. **Conclusions :** Les plasticiens et les chirurgiens orthopédiques ont obtenu des résultats équivalents si l'on comparait les complications périopératoires après des amputations des extrémités supérieures au bout de 30 jours. Selon ces résultats, à la fois les chirurgiens orthopédiques et les plasticiens fournissent des soins de qualité semblables lors d'amputations distales des membres supérieurs.

Keywords
hand fellowship, outcomes, training, upper extremity amputations

Introduction

Access to quality emergent and urgent surgical subspecialty treatment has been a challenge for many hospitals *in the United States* to provide due to lack of availability or shortage of surgical specialists.[1] Call coverage for upper extremity care remains a persistent challenge. The American College of Surgeons (ACS) stratifies trauma centers based on resources and specialist availability into level I, II, or III, with all level I trauma centers required to provide hand surgery and microsurgery capabilities at all times.[2] Wrist, hand, and finger injuries are among the most common reasons for presentation to the emergency department for trauma.[3] As such, both demographic factors and health system inequities *(ie, urban vs rural settings, socioeconomic factors) that affect access to care* underscore the importance of hand surgeons in the provision of emergency surgical services.[4] To find adequate coverage for upper extremity call, hospital systems often draw upon both plastic surgeons and orthopedic surgeons with different training backgrounds to provide hand and upper extremity treatments.[5]

In the United States, hand surgery is a heterogeneous field composed of surgeons trained in orthopedic surgery, plastic surgery, and general surgery.[6] Within the field, a wide range of skills is required to manage the clinical problems of hand surgery patients, including fracture *fixation*, wound *management*, microsurgery *for replants and flaps*, and arthroscopy. Significant variability exists in operative experiences of residents and fellows that become hand surgeons.[6-9] There is significant variability in training programs, with orthopedic hand fellowships emphasizing bone and joint surgery, arthroscopy, and including shoulder and elbow procedures, while plastic surgery hand fellowships emphasize microsurgery, soft tissue injury, *hand fracture fixation,* and wound coverage, *although some orthopedic programs also perform microsurgery with replantation and large reconstructive procedures*.[10,11] Due to the broad scope of cases in hand surgery, training programs integrating both orthopedic surgery and plastic surgery disciplines are becoming increasingly common.[11,12] In addition, many health care systems do not require additional fellowship training in hand surgery or achievement of certificate of added qualification (CAQ) to provide hand surgery treatments. While *United States* orthopedic surgeons taking hand call are usually fellowship-trained, plastic surgeons taking hand call often have not received hand fellowship training, thus further complicating measurements of patient-related outcomes and quality.[13]

With increasing health care costs, the United States government has implemented initiatives to improve outcomes and decrease cost of care.[14-18] Case volume has been shown to correlate with operative outcomes across multiple surgical specialties.[19,20] Training background has been shown to impact outcomes for specific procedures, such as vascular versus general surgeons or surgeons versus interventionists (interventional radiologists or cardiologists) for abdominal aortic aneurysms.[21,22] There is a paucity of literature on outcomes following hand surgery based on training backgrounds *in the United States*. The objective of this study was to compare 30-day perioperative patient outcomes following distal upper extremity amputations between orthopedic and plastic surgeons using the ACS National Surgical Quality Improvement Program (NSQIP).

Table 1. Procedures by Surgeon Specialty.

CPT Code, n (%)			Orthopedics (n = 981)	Plastics (n = 602)	*P* Value
Forearm	25900	Amputation, forearm, through radius and ulna	20 (2.0%)	20 (3.3%)	.114
	25905	Amputation, forearm, through radius and ulna; open, circular (guillotine)			
Wrist/Palm	25920	Disarticulation through wrist	24 (2.4%)	14 (2.3%)	.879
	25927	Transmetacarpal amputation			
Finger	26910	Amputation, metacarpal, with finger or thumb (ray amputation), single, with or without interosseous transfer	937 (96%)	568 (94%)	.299
	26951	Amputation, finger or thumb, primary or secondary, any joint or phalanx, finger, including neurectomies; with direct closure			
	26952	Amputation, finger or thumb, primary or secondary, any joint or phalanx, finger, including neurectomies; with local advancement flaps (V-Y, hood)			

Abbreviations: *CPT*, *Current Procedural Terminology*.

Materials and Methods

Case Selection

A retrospective cohort study was performed using the ACS NSQIP Database from 2005 to 2016. The NSQIP database collects data on more than 130 variables in surgical patients at participating *United States* hospitals. Data collection methodology has been previously described.[23] Dedicated data collectors are used at participating sites. Data collectors undergo extensive training and are audited by NSQIP to maintain quality control and data fidelity.[24] Prior studies have validated the use of the NSQIP to assess surgical complications.[25,26]

Patients were included for analysis if they were treated operatively by an orthopedic surgeon or a plastic surgeon for *an* upper extremity amputation based on *Current Procedural Terminology (CPT)* codes. Forearm amputations were identified using *CPT* codes 25900 and 25905, wrist amputations were identified using *CPT* codes 25920 and 25927, and finger amputations were identified using *CPT* codes 26910, 26951, and 26952 (Table 1). Revision amputations were excluded (*CPT* codes: 25907, 25909, 25929, and 25931).

Primary and Secondary Predictor Variables

The primary predictor variable was treatment provider (orthopedic vs plastic surgeon). Presence or absence of CAQ status in hand surgery was not reported in the NSQIP database and was therefore excluded from analysis. Secondary predictor variables assessed perioperative factors, patient demographics, and comorbidity values. Perioperative variables assessed included operative time, emergency cases, inpatient status, and wound class. Patient demographics assessed included age, sex, and ethnicity. Comorbidities assessed included body mass index (BMI), American Society of Anesthesiologists (ASA) physical status classification, diabetes (insulin-dependent and non-insulin dependent), hypertension requiring medication, smoking status, cardiac disease (history of congestive heart failure, myocardial infarction, angina, peripheral vascular disease, previous percutaneous coronary intervention, or previous cardiac surgery), pulmonary disease (history of chronic obstructive pulmonary disease or concurrent pneumonia), renal disease (history of renal failure or previous dialysis), bleeding disorders (conditions increasing bleeding risk, including vitamin K deficiency, hemophilia, thrombocytopenia, chronic anticoagulation not discontinued prior to surgery), and chronic corticosteroid use.

Primary and Secondary Outcome Variables

The primary outcomes of interest were operative complications leading to mortality and/or return to the operating room within 30 days of the index procedure. Secondary outcomes assessed included perioperative blood transfusion (intraoperatively or postoperatively within 72 hours from time of operation), deep vein thrombosis, pulmonary embolism, sepsis, septic shock, surgical site infection (superficial, deep, organ/space infection), wound dehiscence, unplanned reintubation, ventilator dependence for greater than 48 hours, peripheral nerve injury, pneumonia, urinary tract infection, acute renal failure requiring dialysis, progressive renal insufficiency not requiring dialysis, stroke, coma lasting greater than 24 hours, myocardial infarct, and cardiac arrest.

Statistical Analysis

Continuous variables are expressed as mean $\pm$ standard deviation. Univariate analysis was performed using 2-tailed student *t* tests or χ^2/Fisher exact tests as appropriate. As there were 18 perioperative outcomes assessed, a Bonferroni adjusted α value of .0028 was set as statistically significant to address the problem of multiple comparisons. Otherwise, a α value .05 was set as statistically significant. Statistical analysis was performed using SPSS (SPSS version 25.0; IBM).

Results

A total of 1583 cases met inclusion criteria. Orthopedic surgeons performed the majority of cases at 981 cases (62.0%)

Table 2. Operative Characteristics by Surgeon Specialty.

Characteristic		Data Available	Orthopedics (n = 981)	Plastics (n = 602)	*P* value
Operative time (minutes)		1583 (100)	41.7 ± 36.2	47.1 ± 40.9	**.008**
Emergency surgery, n (%)		1583 (100)	120 (12.2%)	61 (10.1%)	.203
Inpatient, n (%)		1583 (100)	288 (29.4%)	203 (33.7%)	.068
Wound class, n (%)	1	1583 (100)	337 (34.4%)	202 (33.6%)	.575
	2		88 (9.0%)	67 (11.1%)	
	3		208 (21.2%)	126 (20.9%)	
	4		348 (35.5%)	207 (34.4%)	

Statistically significant ($P < 0.05$).

Table 3. Patient Demographics and Comorbidities by Surgeon Specialty.

Characteristic		Data available	Orthopedics (n = 981)	Plastics (n = 602)	*P* value
Age, n (%)	Mean ± SD	1554 (98.2)	54.0 ± 16.3	52.7 ± 15.9	.118
	<60		592 (61.5%)	286 (65.3%)	.244
	60-70		223 (23.2%)	134 (22.7%)	
	71-80		104 (10.8%)	47 (8.0%)	
	>80		44 (4.6%)	24 (4.1%)	
Sex, n (%)	Male	1583 (100)	714 (72.8%)	444 (73.8%)	.672
	Female		267 (27.2%)	158 (26.2%)	
Ethnicity, n (%)	Caucasian	1403 (88.6)	598 (67.0%)	312 (61.1%)	**<.001**
	African American		113 (12.7%)	106 (20.7%)	
	Hispanic		121 (13.6%)	86 (16.8%)	
	Asian/ Pacific Islander		31 (3.5%)	5 (1.0%)	
	Native American/Pacific Islander		29 (3.3%)	2 (0.4%)	
Body mass index, n (%)	18.5-24	1512 (95.5)	277 (29.4%)	193 (33.8%)	.578
	<18.5		21 (2.2%)	13 (2.3%)	
	25-29		300 (31.9%)	171 (29.9%)	
	30-34		194 (20.6%)	113 (19.8%)	
	35-39		87 (9.2%)	51 (8.9%)	
	≥40		62 (6.6%)	30 (5.3%)	
American Society of Anesthesiologists Class, n (%)	1-2	1529 (96.6)	475 (49.8%)	259 (45.0%)	.064
	3-5		478 (50.2%)	317 (55.0%)	
Specific comorbidities, n (%)	Diabetes	1583 (100)	303 (30.9%)	163 (27.1%)	.106
	Hypertension	1583 (100)	466 (47.5%)	274 (45.5%)	.442
	Smoking	1583 (100)	301 (30.7%)	190 (31.6%)	.714
	Cardiac disease	1583 (100)	36 (3.7%)	37 (6.1%)	**.023**
	Pulmonary disease	1583 (100)	64 (6.5%)	23 (3.8%)	**.022**
	Renal disease	1583 (100)	102 (10.6%)	102 (16.9%)	**<.001**
	Bleeding disorder	1583 (100)	97 (9.9%)	45 (7.5%)	.103
	Corticosteroid	1583 (100)	47 (4.8%)	31 (5.1%)	.749

Abbreviation: SD, standard deviation.
Statistically significant ($P < 0.05$).

versus plastic surgeons who performed 602 operations (38.0%) during the study period. Finger amputations comprised the majority of procedures for both orthopedic and plastic surgeons (95.5% and 94.4%, respectively). There were no differences in case distribution between specialties (Table 1).

Operative characteristics are summarized in Table 2. There was a statistically significant but clinically insignificant difference in operative times between specialties (orthopedics: 41.7 ± 36.2 minutes, plastics: 47.1 ± 40.9 minutes, $P = .008$). There were no differences in proportions of emergency surgery, inpatients, or wound class.

Demographic and comorbidity differences of cases by surgical subspecialty are summarized in Table 3. There were no differences in age, gender, or BMI of patients. There were significant differences in ethnic breakdown of patients treated by orthopedic surgeons and plastic surgeons ($P < .001$) as well as several comorbidities.

The top 5 post-operative diagnoses by *International Classification of Diseases Ninth Revision and Tenth Revision* (*ICD-9* and *ICD-10,* respectively) are presented in Table 4A and B, respectively. The most common diagnoses associated with amputations were trauma, gangrene, and osteomyelitis.

Table 4A. Top 5 Post-Operative Diagnosis by Surgeon Specialty (*ICD-9*).

Description	*ICD-9* Code	N	Percent of total	Orthopedics	Plastics	*P* value
Traumatic finger amputation, n (%)	886.0	149	16.0%	96 (17.2%)	53 (14.2%)	.226
Gangrene, n (%)	785.4	87	9.3%	47 (8.4%)	40 (10.7%)	.234
Unspecified osteomyelitis, hand, n (%)	730.24	66	7.1%	43 (7.7%)	23 (6.2%)	.374
Crushing injury of finger(s), n (%)	927.3	40	4.3%	20 (3.6%)	20 (5.4%)	.188
Traumatic finger amputation, complicated, n (%)	886.1	36	3.9%	21 (3.8%)	15 (4.0%)	.837

Abbreviation: *ICD-9*, *International Classification of Disease-Ninth revision.*

Table 4B. Top 5 Post-Operative Diagnosis by Surgeon Specialty (*ICD-10*).

Description	*ICD-10* Code	N	Percent of total	Orthopedics	Plastics	*P* value
Gangrene, not elsewhere classified, n (%)	I96	65	10.0%	44 (10.4%)	21 (9.2%)	.610
Other acute osteomyelitis, right hand, n (%)	M86.141	56	8.6%	10 (8.8%)	11 (8.3%)	.838
Other acute osteomyelitis, left hand, n (%)	M86.142	23	3.5%	11 (2.6%)	12 (5.2%)	.082
Osteomyelitis, unspecified, n (%)	M86.9	18	2.8%	10 (2.4%)	8 (3.5%)	.404
Type 2 diabetes mellitus with diabetic peripheral angiopathy with gangrene, n (%)	E11.52	17	2.6%	17 (4.0%)	0 (0%)	**.001**

Abbreviations: *ICD-10*, *International Classification of Disease-Tenth Revision*.
Statistically significant ($P < 0.05$).

Table 5. Univariate Analysis of Primary and Secondary Outcomes by Surgeon Specialty.

Characteristic		Data available	Orthopedics (n = 981)	Plastics (n = 602)	*P* value[a]
Primary outcome, n (%)	Reoperation	1583 (100)	37 (3.8)	28 (4.7)	.392
	Death	1583 (100)	13 (1.3)	13 (2.2)	.205
Secondary outcomes, n (%)	Perioperative blood transfusion	1583 (100)	10 (1.0)	5 (0.8)	.795
	Deep vein thrombosis	1583 (100)	0 (0)	4 (0.7)	.021
	Pulmonary embolism	1583 (100)	0 (0)	3 (0.5)	.055
	Sepsis	1583 (100)	15 (1.5)	12 (2.0)	.489
	Septic shock	1583 (100)	2 (0.2)	6 (1.0)	.060
	Surgical site infection	1583 (100)	40 (4.1)	29 (4.8)	.484
	Wound dehiscence	1583 (100)	13 (1.3)	6 (1.0)	.560
	Unplanned reintubation	1583 (100)	2 (0.2)	3 (0.5)	.375
	Ventilator >48 hours	1583 (100)	2 (0.2)	3 (0.5)	.375
	Pneumonia	1583 (100)	10 (1.0)	4 (0.7)	.586
	Urinary infection	1583 (100)	3 (0.3)	0 (0)	.293
	Acute renal failure	1583 (100)	2 (0.2)	6 (1.0)	.060
	Progressive renal insufficiency	1583 (100)	1 (0.1)	1 (0.2)	>.999
	Stroke	1583 (100)	1 (0.1)	0 (0)	>.999
	Myocardial infarct	1583 (100)	3 (0.3)	1 (0.2)	>.999
	Cardiac arrest	1583 (100)	3 (0.3)	3 (0.5)	.680

[a]Bonferroni adjusted *P* value set at .0028 for statistical significance.

Orthopedic surgeons and plastic surgeons treated similar proportions of patients with these diagnoses, except orthopedic surgeons treated more patients with gangrene secondary to type 2 diabetes mellitus (4.0% vs 0%, $P = .001$).

Despite several differences in operative characteristics, patient demographics, and patient comorbidities, there were no significant differences between specialties in either primary or secondary outcome variables (Table 5).

Discussion

There is a significant need for hand surgery in the United States health care system, especially for emergent/urgent evaluation in the acute care setting.[27,28] In order to provide comprehensive emergency treatment of hand trauma and acute hand conditions requiring timely treatment, hospitals employ hand surgeons with either orthopedic or plastic surgery backgrounds. In an era of increasing health care costs, there is increasing interest and incentive to reduce early and late complications of surgical procedures.[14,29,30] In the field of hand surgery, there are concerns regarding differences in health care outcomes after acute hand care provided by orthopedic surgeons versus plastic surgeons due to perceived and real differences in training pathways.[5,21,31,32] *For instance, plastic surgery-residency trained surgeons were more likely to perform microsurgical replantation, microvascular, and free tissue transfers than their*

orthopedic colleagues.[32] *There were discrepancies in operative versus nonoperative management of fractures and tendon injuries as well.*[5] *In the United States, reimbursement from Medicare is affected by multiple quality outcomes within 30 days of an index procedure (ie, surgical site infection, readmissions, mortality).*[33] *To the authors' knowledge, study of upper extremity surgery quality outcomes by subspecialty has not been performed.* We sought to study and answer this question, using a large and validated United States health care outcomes database (NSQIP). We demonstrated no differences in 30-day postoperative morbidity or mortality based on analysis of 18 perioperative complications following distal upper extremity amputations between orthopedic surgeons and plastic surgeons. *This study supports that both plastic and orthopedic-trained surgeons can provide similar quality upper extremity surgical care.*

Upper extremity amputations are challenging injuries that often require urgent intervention by providers of hand surgery at hospitals with available resources.[27,34] We found that orthopedic surgeons performed a greater proportion of amputations compared to plastic surgeons (62.0% vs 38.0%). This likely reflects the national breakdown of hand surgeons, with 72.1% being orthopedic surgeons and 18.3% being plastic surgeons.[4] There is evidence of a steady decline in the proportion of plastics-trained surgeons pursuing practice in the field of hand surgery *in the United States*.[35] Reported trends in plastic surgery hand training emphasize microsurgery and wound coverage with flaps and grafts, while orthopedic hand surgeons perform more bone and joint procedures.[5,11,32] Decreasing reimbursement for microsurgery, decreasing replantation volumes, and increased workload may disincentivize plastic surgeons from pursuing hand surgery subspecialization and further decrease plastic surgery participation in acute hand care.[36]

There were no significant differences in practice composition regarding region of amputation nor indication for amputation. The vast majority of distal upper extremity amputations were finger/ray amputations for both plastic surgeons and orthopedic surgeons. Indications for amputation were mostly of traumatic or infectious etiologies. Our study found a statistically significant but not clinically significant difference in operative times between orthopedic surgeons and plastic surgeons (41.7 minutes vs 47.1 minutes, respectively). Orthopedic and plastic surgeons have been reported to have differences in operative approaches to upper extremity injuries, which may be reflected in operative times as was found in our study.[5] Collaborative studies between orthopedic and plastic hand surgeons to explore best practices in hand surgery may identify areas for improving quality of care.

There were differences in ethnic composition of distal upper extremity amputations performed by orthopedic surgeons and plastic surgeons. We found that orthopedic surgeons performed a greater proportion of amputations on Caucasian patients (67.0%) compared to plastic surgeons (61.1%)*, which may be related to practice setting*. Race and socioeconomic disparities have been reported to play a role in the decision to perform amputation and outcomes following amputation.[37-39] African American patients and uninsured patients are less likely to undergo replantation procedures following traumatic finger/thumb amputations than Caucasian patients.[40] Upper extremity amputations have significant implications on the patient career and quality of life. Reasons for the differences in ethnic composition of patients who receive amputations based on surgeon specialty should be further explored. Efforts should be made to reduce barriers to care by both the government and surgeons.

We found no significant differences in perioperative outcomes between orthopedic surgeons and plastic surgeons performing amputations of the distal upper extremity. This suggests that, despite differences in exposure to hand cases and training emphasis, both plastic surgeons and orthopedic surgeons are able to adequately treat cases requiring amputation.[7,8] Of note, the incidence of major complications (death and reoperation) following distal upper extremity amputation (5.7%) was relatively high. This *likely reflects patients with major systemic illnesses preoperatively that manifest in conditions requiring upper extremity amputation, rather than complications directly caused by amputation*. Gangrene and infectious etiologies were among the most common reasons for surgery. *We found that 96 of 1583 patients (6.1%) carried a diagnosis of sepsis prior to surgery.* The majority of patients in this study had an ASA class of 3 or greater, signifying severe systemic disease that is a constant threat to life. These findings suggest that patients requiring amputations are often medically complex. Coordinated multidisciplinary care may therefore improve outcomes of patients who require distal upper extremity amputations.[41]

There are several important limitations to this study, mostly secondary to the nature of the NSQIP database. The NSQIP database is limited to 30-day perioperative outcomes, and likely underreports the rate of complications following distal upper extremity amputations. Long-term and procedure-specific outcomes, such as functional outcomes, pain, and successful healing of amputation site, are unable to be evaluated through this database and should be evaluated in future studies. Specifics about hospitals, surgeon volume, and advanced training (ie, CAQ and fellowship training) are not described in the NSQIP, and may play an important role in post-operative complications.[5,19] Further study is needed on the impact advanced training factors on quality of care for acute hand conditions.

Authors' Note

This article does not contain any studies with human or animal subjects.

Declaration of Conflicting Interests

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