Analysis of National Institutes of Health Funding in Hand Surgery

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Abstract

Background: Federal research dollars help investigators develop biomedical therapies for human diseases. Currently, the state of funding in hand surgery is poorly understood. This study defines the portfolio of National Institutes of Health (NIH) grants awarded in hand surgery. **Methods:** This was a cross-sectional study of hand surgeons in the US. Faculty members of accredited hand surgery fellowships and/or members of the American Society for Surgery of the Hand were queried in the NIH RePORT database for awards obtained during 2005–2015. **Results:** Of 2317 hand surgeons queried, only 18 obtained an NIH grant (0.8%). Thirty-eight unique grants were identified totaling \$42 197 375. R01 awards comprised the majority of funding (78.0%) while K08 awards accounted for 1.1%. The K-to-R transition rate was zero. The National Institute of Arthritis and Musculoskeletal and Skin Disease supported the most funding (65.2%), followed by the National Institute of Neurological Disorders and Stroke (30.8%). There was no statistically significant difference in NIH funding totals with hand surgeon characteristics. Funding supported translational (46.0%), basic science (29.6%), clinical (21.0%), and education-based (3.4%) research. Peripheral nerve (33.3%) and bone and joint disease (30.1%) received the most research funding. **Conclusions:** Less than 1% of hand surgeons obtain NIH research grants. Of the 2 identified K08 awards, none led to a subsequent R award. Future research should identify barriers to grant procurement to design effective policies to increase NIH funding in hand surgery.

Keywords: NIH, grants, research, academia, surgery, hand

Introduction

Levels of research funding from the National Institutes of Health (NIH) have stagnated during the past decade.²⁰ At the same time, academic surgeons have experienced greater barriers to NIH grant procurement due to increased clinical and administrative responsibilities.¹³ Yet obtainment of external research funding is necessary for academic promotion, scholastic achievement, and the advancement of an entire specialty. Historically, successful NIH grant procurement has been considered the gold standard in academic research.

Previous studies have highlighted low levels of NIH funding in the surgical disciplines including general surgery,⁶ plastic surgery,¹⁵ orthopedic surgery,¹⁷ and urology,¹⁶ but none have analyzed hand surgery. Elucidation of the NIH grant portfolio in hand surgery could assist young hand surgeons during the arduous grant writing process.⁵ Specifically, knowledge regarding the most common grant mechanisms, supporting NIH institutes, and clinical interests could help align young investigators with federal grant opportunities.

This study analyzes the portfolio of NIH research grants awarded to hand surgeons. As a secondary objective, we

explored the conversion rate of K-to-R-awards. Since its inception in the 1970s, the K award has been a commonly recognized pathway to the prestigious R award.¹⁰ However, surgeons, relative to non-surgeons, are less likely to apply for and obtain K awards.¹³ Based on this previous research, we hypothesized that few hand surgeons would capitalize on the K-to-R-award transition mechanism to achieve research independence.

Materials and Methods

We performed a cross-sectional study of NIH grants awarded to hand surgeons. Our institutional review board granted review exemption due to the public availability of

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Table 1. NIH Grant Mechanisms Awarded to Hand Surgeons, 2005-2015.

Institute	Total funding (\$)	% of total	No. of grants
R01	32 913 878	78.0	17
ZIA	3 661 819	8.7	1
K24	1 206 622	2.9	1
R21	1 117 752	2.6	3
R03	702 248	1.7	3
R44	535 046	1.3	1
R56	532 000	1.3	1
K08	482 027	1.1	2
M01	392 630	0.9	3
R34	154 500	0.4	1
T32	140 610	0.3	1
R43	137 639	0.3	1
P30	115 854	0.3	1
G13	81 750	0.2	1
R13	23 000	0.1	1
Total	42 197 375	100	38

Note. NIH = National Institutes of Health; ZIA = Intramural Research Funding.

all data. The NIH RePORT (Research Portfolio Online Reporting Tools) database was queried by first and last name of individual hand surgeons.¹¹ A list of names was obtained from directories of the American Society for Surgery of the Hand (ASSH)³ and faculty lists of American Council of Graduate Medical Education-accredited hand surgery fellowship programs.² Hand surgeons serving as principal investigator (PI) or co-PI on NIH research grants were included in this study. Given the limitations of this search strategy, we restricted analysis of NIH awards for the fiscal years 2005-2015. To determine the rate of K-to-R-award transition, we also searched for K awards that preceded this period. K24 (midcareer development awards) were excluded from the K-to-R transition analysis as they are designed for senior faculty.

Data on award mechanisms, NIH institutes, and funding totals were collected. Grant abstracts were categorized by research type (basic, translational, clinical, or education) using similar methods from previous research.⁶ Briefly, basic science research was defined as laboratory investigation focused on understanding biological mechanisms without immediate therapeutic assessment. Translational research was defined as investigation focused on therapeutic and/or diagnostic modalities. Clinical research was defined as human experimentation. Education research was defined as efforts to increase training opportunities. Funding was then categorized by area of clinical interest based on primary foci of grant abstracts: peripheral nerve, tendon, nerve compression, Dupuytren disease, composite tissue allotransplantation (CTA), and bone and joint disease.

Funding totals were presented as medians and interquartile ranges. Kruskal-Wallis and Mann-Whitney *U* tests were used to compare career NIH funding totals by investigator characteristics. All tests were 2-tailed and considered significant if $P < .05$.

Results

The search query identified 2317 hand surgeons, of which 18 received at least 1 NIH award during the study period (0.8%). These hand surgeons received 38 unique NIH grants totaling \$42 197 375. The majority of funding was awarded through the R01 mechanism (78.0%, Table 1). There were 2 K08 awards, which accounted for 1.1% of total funding. Zero K08 awards led to a subsequent R award. Furthermore, of the 17 R01 awards, none were preceded by a K08 award. Table 2 offers a description of each award mechanism.

Eight institutes awarded an NIH grant (Table 3). The National Institute of Arthritis and Musculoskeletal and Skin Disease supported the most grants ($n = 22$, 65.2% of total funding), followed by the National Institute of Neurological Disorders and Stroke ($n = 7$, 30.8% of total funding). The remaining 4.0% of NIH funding was supported by 6 institutes.

Hand surgeon characteristics were correlated with NIH funding totals (Table 4). No statistically significant differences were calculated by sex, obtainment of a secondary graduate degree, residency specialty, or academic rank ($P > .05$).

NIH funding supported translational (46.0%), basic science (29.6%), clinical (21.0%), and education (3.4%) research. Peripheral nerve (33.3%) and bone and joint disease (30.1%) attracted the most research funding (Table 5). Collectively, tendon (21.7%), CTA (7.3%), nerve compression (6.7%), and Dupuytren disease (0.9%) received roughly one-third of total funding.

Discussion

Few hand surgeons receive federal research funding from the NIH. The paucity of K awards suggests a weak pipeline for future R awards, which are the primary mechanisms for NIH research funding. Alarming, the K-to-R-award transition rate was zero, with only 2 K08 awards identified among hand surgeons. Given the small prevalence of K08 grants, future opportunities may exist to encourage young investigators to pursue this funding mechanism. Future research should determine barriers to NIH funding procurement among hand surgeons to increase federal funding for hand surgery research.

K awards can require 50% of an investigator's effort as a prerequisite for funding.⁷ Given the increasing incentives for clinical productivity, few hand surgeons may be able to take

Table 2. Description of NIH Grant Mechanisms Awarded to Hand Surgeons, 2005-2015.

Mechanism	Title	Description
G13	Health Sciences Publication Support Awards (NLM)	To provide short-term assistance for the preparation of book-length manuscripts about important scientific information needed by US health professionals. Grants are awarded for major critical reviews and analyses of historical studies and current developments in informatics, technology, librarianship, and secondary reference materials in the biomedical field. Publication in formats other than print-on-paper (e.g., electronic, film, etc.) are encouraged, as are new and innovative ways of organizing and presenting information. Publication grants do not support journals or other serials and are not suitable for operation of established databases. Work judged to have significant commercial viability will not be supported by these grants.
K08	Clinical Investigator Award (CIA)	To provide the opportunity for promising medical scientists with demonstrated aptitude to develop into independent investigators, or for faculty members to pursue research aspects of categorical areas applicable to the awarding unit, and aid in filling the academic faculty gap in these shortage areas within health profession's institutions of the country
K24	Midcareer Investigator Award in Patient-Oriented Research	To provide support for the clinicians to allow them protected time to devote to patient-oriented research and to act as mentors for beginning clinical investigators.
M01	General Clinical Research Centers Program	An award made to an institution solely for the support of a General Clinical Research Center where scientists conduct studies on a wide range of human diseases using the full spectrum of the biomedical sciences. Costs underwritten by these grants include those for renovation; for operational expenses such as staff salaries, equipment, and supplies; and for hospitalization. A General Clinical Research Center is a discrete unit of research beds separated from the general care wards.
P30	Center Core Grants	To support shared resources and facilities for categorical research by a number of investigators from different disciplines who provide a multidisciplinary approach to a joint research effort or from the same discipline who focus on a common research problem. The core grant is integrated with the center's component projects or program projects, though funded independently from them. This support, by providing more accessible resources, is expected to assure a greater productivity than from the separate projects and program projects
R01	Research Project	To support a discrete, specified, circumscribed project to be performed by the named investigator(s) in an area representing his or her specific interest and competencies
R03	Small Research Grants	To provide research support specifically limited in time and amount for studies in categorical program areas. Small grants provide flexibility for initiating studies which are generally for preliminary short-term projects and are nonrenewable
R13	Conference	To support recipient sponsored and directed international, national, or regional meetings, conferences, and workshops
R21	Exploratory/Developmental Grants	To encourage the development of new research activities in categorical program areas. (Support generally is restricted in level of support and in time.)
R34	Planning Grant	To provide support for the initial development of a clinical trial or research project, including the establishment of the research team; the development of tools for data management and oversight of the research; the development of a trial design or experimental research designs and other essential elements of the study or project, such as the protocol, recruitment strategies, procedure manuals, and collection of feasibility data.
R43	SBIR Grants—Phase I	To support projects, limited in time and amount, to establish the technical merit and feasibility of R&D ideas which may ultimately lead to a commercial product(s) or service(s).
R44	SBIR Grants—Phase II	To support in-depth development of R&D ideas whose feasibility has been established in Phase I and which are likely to result in commercial products or services. SBIR Phase II are considered "Fast-Track" and do not require National Council Review.
R56	High Priority, Short-Term Project Award	To provide limited interim research support based on the merit of a pending R01 application while applicant gathers additional data to revise a new or competing renewal application. This grant will underwrite highly meritorious applications that if given the opportunity to revise their application could meet institute or center recommended standards and would be missed opportunities if not funded. Interim funded ends when the applicant succeeds in obtaining an R01 or other competing award built on the R56 grant. These awards are not renewable.
T32	Institutional National Research Service Award	To enable institutions to make National Research Service Awards to individuals selected by them for predoctoral and postdoctoral research training in specified shortage areas
ZIA	NIH Intramural Research Grant	—

Note. NIH = National Institutes of Health; NLM = National Library of Medicine; SBIR = Small Business Innovation Research; ZIA = Intramural Research Funding.

the financial penalty for accepting a K award. Academic departments may also drive this inability to pursue NIH fund-

ing, as they primarily reward clinical productivity. Yet K awards remain a primary mechanism for NIH funding pro-

Table 3. NIH Institutes Supporting Hand Surgeon Investigators, 2005-2015.

Institute	Total funding (\$)	% of total	No. of grants
NIAMS	27 513 302	65.2	22
NINDS	12 985 970	30.8	7
ZIA	480 203	1.1	2
NCRR	392 630	0.9	3
NICHD	375 250	0.9	1
NIAID	227 660	0.5	1
NIGMS	140 610	0.3	1
NLM	81 750	0.2	1
Total	42 197 375	100	38

Note. NIH = National Institutes of Health; NIAMS = National Institute of Arthritis and Musculoskeletal and Skin Disease; NINDS = National Institute of Neurological Disorders and Stroke; ZIA = Intramural Research Funding; NCRR = National Center for Research Resources; NICHD = National Institute of Child Health and Human Development; NIAID = National Institute of Allergy and Infectious Diseases; NIGMS = National Institute of General Medical Sciences; NLM = National Library of Medicine.

Table 4. Characteristics of Hand Surgeons With NIH Funding, 2005-2015.

	N (%)	Median total funding, \$ (interquartile range)	P
Sex			.654
Female	3	250 524 (3 494 147)	
Male	15	672 685 (3 380 637)	
Graduate degree			.837
Yes	2	4 017 000 (7 574 321)	
No	16	637 798 (3 240 884)	
Discipline			.775
Orthopedic	13	672 685 (3 090 554)	
Plastic	5	602 910 (7 358 815)	
Academic rank			.126
Assistant/associate	7	281 363 (352 386)	
Professor	11	2 849 000 (6 763 376)	

curement, as they allow for preliminary data collection and improvements to grant applications.¹¹ K awardees are 4 times more likely to receive an R01 award relative to non-K awardees.⁷ Furthermore, the K-to-R transition rate exceeds 40% for K awardees. Thus, the abysmal K-to-R transition rate identified in our study should warrant closer investigation. A study of pediatric surgeons found that 39% of K awardees were subsequently awarded an R01 grant.⁸ Thus, it remains possible for surgeon scientists to achieve similar K-to-R transitions rates with physician scientists in medical specialties.⁷ The challenge will remain to motivate the specialty of hand surgery to reward efforts to obtain NIH funding.

Plausibly, hand surgeons may be largely unaware of the K08 mechanism and its importance for future research funding. Clearly, interventions are needed to create a pipeline

of NIH awards in hand surgery, which arguably begins during residency. Divisions of hand surgery must undergo a paradigm shift away from clinical productivity to one that also values protected research time of hand surgeon scientists. Such efforts would require support from professional organizations like ASSH as well as the leadership of departments and divisions of orthopedic and plastic surgery. Furthermore, changes must occur at the residency training level to incorporate formal research training. Orthopedic and plastic surgery residency programs may emulate general surgery residency training, which has both community and university programs. These university programs require 2 years of dedicated research training before graduation. Some general surgery subspecialties, like pediatric surgery, virtually require 2 years of research training before matching, which may help explain the impressive NIH funding rates in this specialty.⁸ Another study of general surgery residents demonstrated a strong correlation between completion of research years and subsequent academic aspirations.¹⁴ However, these research years are costly to residency programs as current graduate medical education funding supports clinical training exclusively. Thus, orthopedic surgery and plastic surgery residency programs must self-fund research training through institutional grants and other funding opportunities. Ultimately, however, these efforts may help increase the ability of future hand surgeons to remain competitive at the NIH level.

Alternative funding mechanisms exist outside of the NIH for academic hand surgeons. ASSH sponsors pilot grant opportunities modeled after NIH awards to create a pipeline of future federal research grant applications.¹ ASSH grants afford opportunities for critical feedback and preliminary data collection to strengthen subsequent R award proposals. Similar opportunities exist from other organizations such as the Orthopedic Research and Education Foundation,¹² the Plastic Surgery Foundation,¹⁹ the American Society for Peripheral Nerve, and the American Society for Reconstructive Microsurgery.¹⁸ Ultimately, these pilot grant opportunities are designed to foster subsequent NIH award applications.

This study had several limitations. First, the small cohort of hand surgeons with NIH funding limited the analysis of investigator characteristics and NIH funding totals. Previous studies have demonstrated a gender disparity in federal research funding,^{9,21} which was not replicated in our study. However, women are underrepresented in hand surgery,⁴ and future efforts are needed to identify unique barriers to grant procurement among women hand surgeons. Second, this study demonstrated a paucity of NIH grants in hand surgery, but did not identify its etiology. The NIH RePORT database does not list non-funded grant applications. Thus, the low levels of NIH funding in hand surgery may be attributable to low application rates or poor conversion rates. Last, this study focused solely on NIH awards while

Table 5. National Institutes of Health Funding in Hand Surgery by Area of Clinical Interest, 2005-2015.

Clinical area	Total funding, \$ (% of total)	No. of grants
Peripheral nerve	14 063 040 (33.3)	10
Bone and joint disease	12 693 889 (30.1)	13
Tendon	9 150 435 (21.7)	7
Composite tissue allotransplantation	3 071 495 (7.3)	3
Nerve compression	2 825 886 (6.7)	2
Dupuytren disease	392 630 (0.9)	3

excluding other federal research opportunities from the Veterans Administration and Department of Defense. Future studies should assess the impact of these federal organizations as well as private industry grants.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

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

Statement of Informed Consent

Informed consent was obtained when necessary.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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