

# The Required Research Rotation in Residency

*The University of Pennsylvania Experience, 1978–1993*

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**The University of Pennsylvania orthopaedic surgery residency program under the direction of Dr. Carl T. Brighton was uniquely structured to require a year of research as part of a 5-year program. This requirement was instituted to foster critical thinking, and not necessarily to produce academic orthopaedic surgeons. Nonetheless, measures of academic productivity of the 127 residents who trained under Dr. Brighton's leadership may be instructive. The purpose of this study was to assess metrics of academic productivity. In addition, the six current and former chairmen of orthopaedic surgery programs who performed research while residents at the University of Pennsylvania were surveyed for their impressions regarding required research rotations. Fifty-nine percent of the University of Pennsylvania residents took faculty positions after training; 75% published a peer-reviewed paper after residency; and 17% are current members of the American Orthopaedic Association. Overall, the chairmen surveyed found great value in their own resident research experience, but none have replicated the Brighton model of residency organization. Only two of the six programs have a research year: at both, this research rotation is in addition to the standard 5 years of clinical education and only at one are all residents required to participate.**

For many years, the University of Pennsylvania's Department of Orthopaedic Surgery required a year-long research rotation from all of its residents. This research rotation was taken in lieu of a second year of general surgery education or a fourth year of clinical orthopaedic education. That is, the University of Pennsylvania residency program was structured as 1 year of general surgery, 1 year of orthopaedic research, and 3 years of clinical orthopaedic sur-

gery education. In contrast, all other programs in the United States were structured as 2 years of general surgery followed by 3 years of orthopaedic studies, or 1 year of general surgery followed by 4 years of orthopaedic studies. To our knowledge, the University of Pennsylvania program at the time was the only program with research as an integrated part of the residency, supplanting some clinical education (other programs may have had a year of research, but only in addition to the standard clinical education).

The goal of the University of Pennsylvania residency, as articulated by Dr. Carl Brighton, chairman of the department from 1978 to 1993, was to train competent, critically thinking orthopaedic surgeons. The research requirement was instituted to help reach that goal. The program was not fashioned to train academicians. Fostering the development of clinician-scientists was only an aim to the extent Penn-trained orthopaedic surgeons would have, in the spirit of science, a healthy sense of inquiry. In contemporary terms, the goal was to educate practitioners of evidence based medicine as defined by Sackett et al;<sup>3</sup> that is, doctors who would make “. . . conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients . . . and [integrate] individual clinical expertise with the best available external clinical evidence from systematic research.”

We attempted to assess the effectiveness of the University of Pennsylvania approach. Yet given that the goal of the Penn residency program was so broadly defined, there are no rough and ready metrics to assess success. That is, determining whether or not a Penn trained orthopaedic surgeon is a critical thinker is both subjective and open to confounding factors. The question could be asked, however, if the Penn method is an apt means to train future academicians. To reiterate, that was not the program's goal. Nonetheless, evaluating the career paths of Penn graduates may generate a meaningful proxy measure of success and provide information to those working to structure their own programs. To that end, we assessed four

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variables: the rate at which Penn residents from this era took faculty positions on the completion of their education; authorship of at least one peer-reviewed Index Medicus publication after residency; membership in the American Orthopaedic Association (AOA); and participation in a postresidency fellowship. These are admittedly imperfect metrics of academic productivity, let alone critical thinking. The face validity of these measures is left to the reader.

Evidence is also offered in the form of expert opinion, namely, the survey responses of the six current and former orthopaedic residency program chairs who trained at Penn and performed year-long research rotations. These individuals and the departments they led were: John Cuckler, University of Alabama; Joseph Iannotti, Cleveland Clinic Foundation; Richard Lackman, University of Pennsylvania; Joseph Lane, University of California, Los Angeles; Claude Nichols, University of Vermont; and Sam Wiesel, Georgetown University.

## MATERIALS AND METHODS

We compiled a list of all 127 living Penn residents who graduated in the years 1978 through 1993. This period represents the graduating classes during the tenure of Dr. Carl Brighton as chair. All of these residents performed year-long research rotations. Although many residents before 1978 performed research rotations and although the program endured after Dr. Brighton's retirement as chairman in 1993, we chose this 15-year window for consistency and to allow adequate time for followup. We obtained fellowship information for 117 of the 127 former residents. Particular attention was given to the fellowship activity of residents graduating in 1989 and beyond, as this group was required to perform only 3 years of clinical orthopaedics at a time when all other programs required 4 years of orthopaedic surgery (before 1989, some other programs required only 3 years of orthopaedic study, with the other year spent in general surgical residency).

We obtained the following information: whether the resident took an academic position after residency education; whether the resident completed a clinical fellowship; whether the resident published at least one peer-reviewed Index Medicus paper in the years after residency; and whether the resident is a current member of the American Orthopaedic Association (AOA). We obtained information regarding fellowship and postresidency employment from the University of Pennsylvania's Department of Orthopaedic Surgery. If information was not found there, we conducted an Internet search. When an Internet search yielded no results, we attempted direct contact. Publications were assessed via PubMed. We consulted the AOA 2005 directory to determine membership.

The six current and former chairmen identified above (one of whom, Dr. Wiesel, also served as medical school dean) were asked about their experiences as a resident, the impact they perceived resulted from their research experience, and their opin-

ions regarding the value of imposing a research requirement at their current home institution. The survey and responses are shown in Table 1.

## RESULTS

Seventy five of the 127 (59%) residents took faculty positions after completion of their residency and 46 did not. We could not conclusively establish faculty appointments for six former residents and we therefore assumed they had not taken faculty positions.

Ninety-four residents (75%) published at least one peer-reviewed paper after residency. No citations could be found for the remaining 33.

Twenty-one (17%) of the residents are current members of the AOA.

Of the 117 former residents for whom we had fellowship information, 86 (74%) completed a fellowship and 31 did not. A clinical fellowship was completed by every resident from the class of 1989 and all classes thereafter.

The program produced six current and former orthopaedic chairs, all of whom noted positive features of the residency research requirement. None of the chairs have implemented a year-long research rotation at their institution supplanting a year of clinical education, although two programs offer a 6-year track with a year of research in addition to the standard 4 years of clinical orthopaedics. The Cleveland Clinic program requires 1 year for all residents and Penn offers this for two of the eight residents each year.

## DISCUSSION

The Penn residency program under the leadership of Dr. Carl Brighton was structured to foster critical thinking. As part of that effort, a year-long research rotation was required of all residents. The success of this residency program in reaching its stated goal is difficult to assess, but we demonstrated many of the graduates were academically productive. Most took faculty positions on completion of residency and a larger majority authored a scientific paper.

We note several limitations. First, as an experimental design this is a case series, not a controlled experiment. Accordingly, many biases must be considered. For example, there may be a selection bias, namely, that the residents chose Penn (or were chosen by the faculty there) precisely because of anticipated potential in academics. Along those lines, one must consider the residency program in some way even hindered its graduates; it is possible their achievements could have been greater had they trained elsewhere. In other words, the Penn residents may have been academically successful despite having trained

at Penn, not because of it. There also may be confounding factors within the residency itself; that is, the year of research was not the only unique aspect of the Penn program, and perhaps it was one of the other unique features stimulating the residents. The assessment of the graduates' postresidency activity was also not very precise. Every Index Medicus citation was credited as a publication, with no attempt made to ascertain if the publication was even in the realm of musculoskeletal medicine. Likewise, the nature of the faculty appointment was not scrutinized. A clinical appointment to a medical school faculty was not distinguished from a tenured position for full time research. The methods employed also emphasize quantity over quality. A program from which 60% of graduates take faculty positions and 75% write at least one paper may be less academically productive (by some standards) than one which graduates only one scientist who goes on to win the Nobel Prize. Furthermore, because we did not assess how many, if any, of the manuscripts published after residency were based on work performed post-residency, we cannot infer that any interest in research was enduring. If the measured data from the 15 residency classes represent a case series, the survey responses of the chairs who trained at Penn (henceforth designated, the chairs) stand as anecdotal evidence. Their responses have to be considered influenced by recall bias, cognitive dissonance, and perhaps a desire to appear politically correct. This use of anecdotal evidence may not be necessarily a limitation of the study but rather simply a feature. For the most part, all decisions from certifying organizations regarding residency educational requirements are based on anecdotal evidence. Even the vaunted Flexner report<sup>2</sup> was an observational study.

The chairs looked favorably upon their experience and rated it successful, yet none has replicated at his/her institution the program as it existed at Penn during the Brighton era. The chairs cited a variety of reasons, including finances, faculty and resident interest, and the imperatives of clinical education.

Based on the collected data, the survey responses, and our own experiences, we offer the following observation: a universal year-long basic science research rotation for all residents supplanting a year of clinical education is a poor policy.

Demanding a year-long research rotation from residents may not be suited to every residency program, some of which are not based at medical schools and do not have a substantial research infrastructure. To create a meaningful experience, there has to be a critical mass of faculty members, research space, and funding, among other necessary ingredients. This may not be present at all the programs. It is not elitism but pragmatism motivating us to say a research rotation is not for every program.

The length of the optimal rotation, likewise, is not necessarily 1 year. Acquiring a taste of basic science research may not need an entire year; developing the skills and experiences to become a competent clinician scientist will take more. There are many arguments for having a rotation of 12 months' duration, most notably, it is the atomic unit of residency; the Y in PGY of course stands for year. Still, it must be recognized a meaningful research rotation is not necessarily this length only.

If research is chosen, it need not be only basic science. Medicine is of course based on biology, but modern practice spans more than basic science. Accordingly, if a program were to strive to broadly train its graduates beyond the confines of clinical orthopaedics, it would be reasonable to include academic pursuits that are not necessarily basic science. Dual degree medical students at the University of Pennsylvania, for instance, can pursue the study of clinical epidemiology, history, and anthropology (and perhaps more tangentially, the subjects of business and law) while working towards their medical doctorate.

To be sure, not all medical school applicants to residency programs are interested in engaging in research for a year, be it in addition to or instead of clinical rotations. Along those lines, were a program to require research from all of its residents, it would not be able to avail itself of the entire talent pool; some students will shun the program and not apply. Given there are approximately two qualified applicants for every available residency position (and if the field of orthopaedic surgery were ever able to recruit from the female half of the medical school crop<sup>1</sup> there might be four or more qualified applicants for every seat), limitations on access to the talent pool may not be crippling. Still, it must be considered that requiring research may shunt a potential clinical superstar to another program.

If a universal year-long basic science research rotation for all residents supplanting a year of clinical education is a poor policy, what, then, is a good policy? Simply, some programs should offer (or require) research rotations of 1 year or longer to some residents in addition to the basic 4 year course of clinical education. The institutions offering these rotations should be suited to the task, having adequate space, funding, and faculty expertise. The residents selected for this should be uniquely chosen for the program based on their own skills, experience, and aspirations.

The ideal research experience should be tailored to the skills and interests of the given resident. If there are  $n$  projects and  $n$  residents at a given program, it is not always easy to match everyone optimally. Far better would be an arrangement whereby the resident could genuinely match his or her skills and interests to a large selection of research projects. Allowing visiting rotations would of

**TABLE 1. Survey and Responses**

Question	Responses
Why did you come to Penn for your residency?	<ul style="list-style-type: none"> <li>● Research: 4</li> <li>● Personal: 1</li> <li>● Clinical opportunities: 1</li> <li>● All noted this was important</li> </ul>
How important was it to you to be able do research as part of your residency?	
How long was your residency (in years)? How was it structured?	<ul style="list-style-type: none"> <li>● General surgery, one year; Research, one year; Clinical Orthopedics three years: 5</li> <li>● General surgery, two years; NIH research fellowship, two years; Penn based research, one year; clinical Orthopedics three years: 1</li> </ul>
Did you do a fellowship post-residency? If so, in what area?	<ul style="list-style-type: none"> <li>● No fellowship: 4</li> <li>● Sports fellowship: 1</li> <li>● Tumor fellowship: 1</li> </ul>
What was your research project?	<ul style="list-style-type: none"> <li>● Study of role of intracellular calcium in extracellular matrix mineralization in growth plate cartilage</li> <li>● Study of the glycerophosphate shuttle in epiphyseal cartilage</li> <li>● Fracture healing basic science; dealt with in vitro fracture healing and trying to develop a model in fetal Sprague Dauley rats.</li> <li>● In vitro fracture healing; metabolism of articular cartilage.</li> <li>● Electrical stimulation of bone to prevent osteoporosis</li> <li>● cis-hydroxy proline analogue to prevent collagen synthesis and to prevent scar during tendon repair</li> </ul>
How did you choose your research program at Penn?	<ul style="list-style-type: none"> <li>● Resident preference: 2</li> <li>● Mentor's advice: 2</li> <li>● Lottery: 1</li> <li>● Don't recall: 1</li> </ul>
Did you publish on this topic?	<ul style="list-style-type: none"> <li>● Yes: 5</li> <li>● No: 1</li> </ul>
Did you ever work in this area again?	<ul style="list-style-type: none"> <li>● No: 4</li> <li>● Significant continuation but then changed career emphasis: 1</li> <li>● Continued work with significant contribution: 1</li> <li>● Positive practical impact: 2</li> <li>● Positive attitudinal impact: 4</li> </ul>
How did your experience in research impact your career (if at all)?	
Did this research experience ever help you with non-research activities?	<ul style="list-style-type: none"> <li>● Yes (methods, attitudes etc): 4</li> <li>● No: 2</li> </ul>
Did you feel deficient in any clinical area because of the time in research?	<ul style="list-style-type: none"> <li>● No: 4</li> <li>● Yes, but fellowship compensated: 1</li> <li>● Yes, but military service compensated: 1</li> </ul>
Please briefly describe your research work after Penn.	<ul style="list-style-type: none"> <li>● Unrelated to residency project: 4</li> <li>● Continuation: 2</li> </ul>
Can you relate any of your research experience to your clinical career?	<ul style="list-style-type: none"> <li>● Yes: 5</li> <li>● No: 1</li> </ul>
Can you relate any of your research experience to your administrative career?	<ul style="list-style-type: none"> <li>● Yes: 3</li> <li>● No: 3</li> </ul>
Does the residency program you lead require research? If so, how much?	<ul style="list-style-type: none"> <li>● No specific rotation but completion of project required: 1</li> <li>● Specific (brief) rotation required of all residents in a five-year track: 1</li> <li>● Specific one-year basic or clinical research rotation required of all residents in a six-year track: 1</li> <li>● Specific rotation required of some (two of eight) residents in a six-year track, and project required of all: 1</li> </ul>
Please state your agreement or disagreement with the following statements:	
In a "perfect world," a year long research rotation for all residents should be required (assuming money was not an issue).	<ul style="list-style-type: none"> <li>● Agree: 1</li> <li>● Disagree "research is not for all programs": 4</li> <li>● Disagree, "research is not for all residents within a given program": 1</li> </ul>
The 80-hour workweek does not leave me with enough manpower to have a research year.	<ul style="list-style-type: none"> <li>● Agree: 1</li> <li>● Disagree, Ancillary help makes up deficit: 1</li> <li>● Disagree, Extending residency by a year adds manpower: 1</li> <li>● Disagree, No stated reason: 3</li> </ul>

**TABLE 1. Survey and Responses (Continued)**

Question	Responses
If my program required a year of research, the quality of applicants would change.	<ul style="list-style-type: none"> <li>● Not an issue, surplus of good applicants: 1</li> <li>● Don't know: 1</li> <li>● Variation on "Applicants will be redistributed". Research-interested residents will go to research oriented programs: 4</li> </ul>
If my program required a year of research, fewer women and minorities would apply.	<ul style="list-style-type: none"> <li>● No: 4</li> <li>● Yes: 1</li> <li>● Fewer minorities, more women: 1</li> </ul>
If my program required a year of research, I would have to change the nature of my faculty.	<ul style="list-style-type: none"> <li>● Yes: 4</li> </ul>
If my program required a year of research as part of a FIVE year program—not an extra year—my residents would graduate with unacceptable clinical deficiencies.	<ul style="list-style-type: none"> <li>● No: 2 (both of which have year long research tracks in place)</li> <li>● Unanimous Yes</li> </ul>
Not all programs are able to graduate clinician scientists; this is the responsibility of large and elite residency programs, primarily.	<ul style="list-style-type: none"> <li>● Unanimous Yes</li> </ul>
There are better ways to train clinician scientists than a year of research in residency.	<ul style="list-style-type: none"> <li>● Yes, more time than one year needed: 5</li> <li>● Don't know: 1</li> </ul>
A year of research as part of residency can be justified on the basis of improved critical thinking, even for residents who do not plan an academic career.	<ul style="list-style-type: none"> <li>● Yes: 0</li> <li>● No, better ways to teach critical thinking: 1</li> <li>● No, research helps critical thinking but it's just not cost effective: 5</li> </ul>
Given the amount of student loan debt carried by the average resident, 5 years of training is all we can ask of them.	<ul style="list-style-type: none"> <li>● Agree : 3</li> <li>● Agree, but for exceptional resident it's ok: 2</li> <li>● Disagree 1</li> </ul>
Given the explosion of medical knowledge in orthopedics, 5 years of training is barely enough.	<ul style="list-style-type: none"> <li>● Unanimous Yes—but none suggested a sixth clinical year (yet)</li> </ul>
Are there any changes in residency in general that you would like to make?	<ul style="list-style-type: none"> <li>● Variations on the theme of "always looking to improve, but things are pretty good": 5</li> <li>● Need more structured curriculum: 1</li> </ul>

course facilitate this, as the set of projects from which the resident could choose would be naturally bigger.

It is reasonable to ask how much sacrifice can be expected from residents themselves. Extending the residency period extends the period of relatively lower wages. Ideally, salaries during the added years would be supplemented so the financial cost would not be an overwhelming deterrent to choosing this path. At the least, it must be made certain residents will not be forced to sacrifice their clinical education. The primary reason to attend residency is for education and certification as a clinician. Nothing that erodes the clinical experience—however enhancing it may be academically—should be allowed.

We believe some programs ill-suited to offering research rotations, but even those well-suited may need special financial support, especially if they are to host visiting resident rotations. The profession as a whole benefits from a critical mass of researchers, not only to sustain scientific endeavors but to train future leaders. These benefits of a research program do not necessarily accrue to the home institution alone but rather to the orthopaedic surgery community at large.

Decisions about the shape of residency requirements, like decisions about parenting, cannot always be made on the basis of hard data. Instinct, experience, and intent all must play a role. Likewise, the fruits of residency education, like the fruits of good parenting, are not always immediately obvious. Information presented here suggests the Penn program in the Brighton era attained some objective measure of success. It must be left to others to decide whether more could have been done then, and whether this approach, or variants of it, should be applied in other places and in other times.

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