**Introduction**

Training the next generation of academic spine surgeons is an important goal for many spine surgery fellowships, which may base selection criteria at least in part on the perceived likelihood of a candidate pursuing an academic career. Unfortunately, there are no established predictive criteria to assist fellowship programs in the selection process. To those on selection committees, certain objective applicant factors might seem to be intuitively associated with academic career choice, such as academic pedigree, prior research accomplishments, and the assessment of mentors who have trained and know the applicant well. Our empirical experience, however, has been that applicants who seem to be “sure bets” for academia not infrequently fail to do so.Previous studies have attempted to model factors influencing career path in academic medical subspecialties, but no study has analyzed similar factors with respect to academic orthopedic surgery, or academic spine surgery in particular([1-19](#_ENREF_1)).

Although career choice is clearly multifactorial and influenced by a variety of factors beyond the scope of a fellowship application (e.g., desired income level, leisure time, geographical constraints, availability of a suitable academic position at the time, and family obligations), we hypothesized that there may be qualities predictive of a greater likelihood of pursuing an academic career. In this study we evaluated objective factors contained within fellowship applications to determine if there is an association between those factors and entering an academic spine practice immediately upon completion of fellowship.

**Methods**

The study included 203 consecutive applications submitted to a single academic orthopedic spine fellowship position over a six year span (2005-2010) and all fellows that had completed their fellowship at that institution (1989-2010). Characteristics that could be objectively analyzed in the application were studied. These factors included:membership in college and medical school academic honor societies (Phi Beta Kappa, Alpha Omega Alpha); number of scientific publications during medical school; number of scientific publications during residency; total number of scientific publications; number of book chapters/reviews; number of national presentations; number of first author scientific publications and presentations; age; completion of an additional degree (e.g., Masters or PhD); completion of an extra year off in a sponsored research fellowship (e.g., National Institute of Health (NIH) or Howard Hughes); prior experience of having had teaching jobs; marital status; participation in intercollegiate level athletics; graduation from a top 20 undergraduate or medical school (US News and World Report 2010 criteria); attendance in a residency with a spine fellowship; and comments made in personal statements and letters of recommendation.

Comments made in personal statements were analyzed with respect to the applicants’ career aspirations. These aspirations were classified into four categories: 1) stated desire to become an academic spine surgeon; 2) unsure/ no mention; 3) desire to enter private practice; or 4) desire to practice in an “academic setting,” teach, or to be somehow involved with research but without a clearly stated desire to become an academic faculty member. Comments made in letters of recommendation were analyzed with respect to the letter writer’s assessment of the applicant’s career path and were divided into four categories: 1) likely to become an academic spine surgeon; 2) no mention; 3) likely to enter private practice; or 4) that the applicant would be actively recruited for a faculty job back at the home institution.

The primary outcome was type of job the applicant took taken immediately upon graduation from fellowship. An academic job was defined as having a title of clinical faculty or a level of professorship at a teaching institution. All applicants were contacted via email, letter, or phone in regards to number and type of jobs taken since completion of fellowship. The outcome of applicants that could not be reached personally was determined by contacting the respective fellowship director. If that could not be done, then the outcome was searched via the Internet.

The chi-square or Fisher’s exact test was used to determine the potential association between covariates and outcome. Multiple logistic regression was used to determine the effects of predictive criteria on type of job (academia or private) taken immediately upon graduation by using backward stepwise covariate selection and by including only factors that were each significant to a p-value of <=0.05. The odds ratio and its 95% confidence interval were calculated for each factor in the presence of the others in the final model.

**Results**

*Choice of an academic job*

201 of the 203 applicants reviewed were men. Initial job status was successfully determined in all 203 applicants. Job status was categorized in 62% of the applicants after contact personally or via fellowship director, with the remainder being categorized by internet search. 74 applicants (36%) had taken an academic job as their first job upon completion of fellowship, while 129 applicants (64%) chose a first job in private practice.

*Univariate analysis – statistically significant factors*

**Table 1** lists the factors evaluated in the univariate analysis. Fivefactors were significantly associated (p ≤ 0.05) with choice of an academic job**(Table 2**).

First, those completing a sponsored research fellowship were significantly more likely to pursue academia than those who did not (p=0.01), with 49% (37/76) taking an initial academic job. In contrast, of those who had not participated in a sponsored research fellowship, only 29% (37/127) took an academic job.

Second, those who matriculated from a top 20 medical school were significantly more likely to enter academics (p=0.02), with 50% (28/56) doing so. In contrast, of those matriculating from medical schools outside the top 20, only 31% (46/147) entered academics.

Third, of those who completed ≥ 5 national presentations, 51% (25/49)entered academics. In contrast, of those with 1-4 presentations or those with 0 presentations, 34% (31/91) and 29% (18/63) entered academics, respectively. Applicants who had ≥5 national presentations were significantly more likely to pursue academia compared to those without any presentations (p=0.02) and those with 1-4 presentations (p=0.05). There was no significant difference in career choice when comparing those with none versus 1-4 presentations (p=0.47)**(Table 2).**

Fourth, a stated desire to enter academics was also highly significant (p=0.001), with54% (35/65) of those clearly stating a desire for an academic job doing so**(Table 2).** The percentage of those stating a desire for private practice who actually took an academic first job was 5.9% (1/17). That percentage was 29% (20/68) for those who were unsure/ no mention, and it was a similar 34% (18/53) for those with a stated desire to work in an “academic setting.”Furthermore, applicants with clear academic aspirations were statistically more likely to pursue academia versus those with private practice goals (p=0.006), those who were unsure/ no mention (p=0.005), and those desiring an “academic setting”(p=0.032)**(Table2).**Although those desiring an “academic setting” were also significantly more likely to pursue academia than those desiring private practice (p=0.049), they were notmore likely when compared to those were unsure/no mention(p=0.593). Lastly, those who were unsure/no mention trended to be more likely to pursue academics than those with private goals (p=0.075), but this result was not statistically significant**(Table 2).**Thus, those with a stated desire to enter private practice rarely entered academics.

Fifth, certain statements made in the letters of recommendation were significantly associated with obtaining an academic job**(Table 2).** 47% (24/51) of those with a letter of recommendation predicting the candidate would enter academics took an academic job. 52% (16/31) of those with letters of recommendation stating that the candidate would be actively recruited back to theirresidency institution took an academic job. In comparison, none of the candidates whose letters predicted a career in private practice entered academics (although there were only 2 such candidates), and only 29% (34/119) of those with letters that were unsure/ no mention entered academics. There was no significant difference between those with letters predicting an academic career versus those being recruited back to their residency institution(p=0.689)**(Table 2).**In contrast, applicants with letters predicting academics were significantly more likely to become academic surgeons compared to those whose letters were unsure/no mention(p=0.021). Those being recruited back to the residency institution were also significantly more likely to enter academia versus those whose letters were unsure/ no mention (p=0.018).

*Univariate analysis – non significant factors*

The remaining factors studied in the univariate analysis were not significantly associated with taking an academic job**(Table 3)**.

Demographic factors such as age or marital status were not significant. 37% (69/189) of those less than 35 years at the time of application entered academics, versus 31% (4/13) of those 35 and older. 36% (36/101) of those who were married at the time of application entered academics, versus 38% (38/101) of those who were not married. Gender was not of significance, but there were only 2 female applicants in this study.

Other than attending a top 20 medical school, academic pedigree was not statistically significant. 41% (26/63) of those attending top 20 colleges entered academics, versus 34% (48/140) of those who did not (p=0.35). 38% (23/61) of those attending a residency at an institution listed in the US News and World Report top 20 for orthopaedic care in 2010 entered academics, versus 36% (51/142) of those who did not (p=0.87). However, graduating from a residency that had an associated spine fellowship did demonstrate a trend toward statistical significance (p=0.06). 43% (45/105) of those whose residency had a spine fellowship entered academics, versus 30% (29/98) of those whose residency did not have a spine fellowship.

Election to academic honor societies during college (Phi Beta Kappa) or medical school (Alpha Omega Alpha) was not significant. 39% (15/39) of Phi Beta Kappa members entered academics, versus 35% (44/123) of those who were not members. 38% (30/80) of Alpha Omega Alpha members entered academics, versus 36% (44/123) of those who were not members.

Additional life and/or academic experiences were not significant. 41% (12/29) of those with additional degrees (Ph.D, MBA, JD, Masters) entered academics, versus 36% (62/174) of those without additional degrees (p=0.54). Prior experience in teaching was not significant, although there was a slight non-significant trend, with 41% (44/108) of those with a prior teaching job versus 32% (30/95) of those without such experience entering academics (p=0.19). Intercollegiate athletic experience was also not significant, with 41% (11/27) of athletes entering academics versus 36% (62/173) of non-athletes (p=0.67).

Although the number of national presentations was significant, as noted above, other aspects of a candidate’s academic productivity only demonstrated trends toward statistical significance. 52% (17/33) of those with ≥5 total publications entered academics, versus 36% (41/113) of those with 1-4 total publications and 28% (16/57) of those with no publications (p=0.08). These trends were similar regardless of whether the publications occurred before or during residency. The number of first authorships on either national presentations or publications did not have a significant effect on choice of an academic career. The number of book chapters written by the applicant was not significant, with 44% (4/9) of those writing ≥5 chapters entering academics versus 41% (32/79) of those who wrote 1-4 (p=0.5).

*Multivariate analysis*

In a multivariate logistical logistic regression model (**Table 5)**,participating in a sponsored research fellowship, attending a top 20 medical school, andclearly stated desire in the personal statement were most highly associated with academic career choice. In the multivariate analysis, those participating in a sponsored research fellowship were 1.88 times more likely to enter academics (p=0.04), whereas those matriculating from a top 20 medical school were 2.02 times more likely (p=0.03). A clearly stated desire to enter academics was most significantly associated with an academic job. Those with a clearly stated desire to enter academics were 2.27 times more likely to do so versus those stating a desire to work in an “academic setting” (p=0.04), 2.56 times more likely than those who were unsure/ no mention (p=0.01), and 12.5 times more likely than those with a stated desire for private practice (p=0.02). Those desiring an “academic setting” were as likely to enter academics as those who were unsure/ no mention, but this was not significant (odds ratio 1.14, p=0.75). Those desiring an “academic setting” were 5.88 times more likely to enter academics versus those who stated a desire for private practice, and those who were unsure/ no mention were 5.0 times more likely to enter academics than those desiring private practice, but these odds ratios were also not significant.

Eleven applicants had taken an academic job first but switched to private practice, and one applicant switched from private to academics. The first job decision was used for the primary analysis. Of the twelve applicants that changed jobs from a different arena to another, 11 changed from academics to private while one changed from private to academics. The applicant that changed from private to academics went to a top 20 US news medical school, did not mention career ambitions in the personal statement, and took a year off for research. This applicant also attended a residency program with a spine fellowship and had ≥5 total scientific publications and first authorships. The other eleven applicants all attended top 20 medical schools, 5/11 mentioned academic medicine in their personal and the remaining 6 did not mention or were unsure. Five of the eleven also took research time off. Seven of the eleven attended residencies with spine fellowships. Research-wise, 3/11 had no scientific publications, 2/11 had more than 5 scientific publications, and six had less than 5. Six of the eleven had no first authorships while the remainder had less than 5 first authorships.

**Discussion**

In the present study, we analyzed 203 consecutive applications to an academic orthopaedic spine fellowship in order to identify factors that may be associated with taking an academic job immediately upon completion of the fellowship. The most strongly associated factors were: having participated in a sponsored research fellowship, attending a top 20 medical school, having ≥5 national presentations,clearly stated desire in the personal statement to become an academic surgeon, and letters of reference stating a high likelihood of pursuing academics or hiring the applicant back to the residency department. Therefore, we conclude that there are objective factors contained in fellowship applications that are associated with a higher likelihood of taking an academic job upon completion of the fellowship. However, there are also clearly many external factors beyond the scope of an application that mayimpact upon an applicant’s ultimate career choice – not the least of which is the availability of a suitable academic job at the time. Accordingly, even these statistically significant factors were associated with procuring an academic job only 47-54% of the time???.

Prior studies have also demonstrated associations between research and careers in academic medicine. In neurology residents, publishing before and during residency was associated with continued post-residency publication rates([20](#_ENREF_20)). Segal et al([21](#_ENREF_21)) surveyed 567 graduates of medical schools and found a strong association between medical school research experience and postgraduate research involvement. Brancati et al studied 944 male physicians who graduated from The Johns Hopkins University School of Medicine from 1948 through 1964 and found that, of the 45% who had chosen academic careers, scholastic performance and research experience in medical school were independently associated ([22](#_ENREF_22)). Publishing during residency also increased the likelihood of entering academic medicine in cohort of 119 radiologists([7](#_ENREF_7)). In a systematic review, completion of research and publication in medical school and residency was associated with a career in academics([23](#_ENREF_23)). In the present study, we also found a significant association between research and procuring an academic job, but of the various facets of research productivity investigated, the only aspect demonstrating statistical significance was among those with ≥5 national presentations. Furthermore, we did not find a strong correlation with various facets of research productivity in our multivariate regression analysis model. One reason may be due to the highly competitive nature of orthopaedic residencies and thus also of the average spine fellowship applicant. As a result, the majorityhas participated in research, and some have already published their work. In addition, many orthopaedic residencies require publication-worthy research projects to be completed during residency which may “dilute” the impact of the research factor by failing to separate those with a true interest in academics versus those who do so by requirement or as a means ofmerely enhancing their applications. This may explain the significant difference between those with ≥5 versus 1-4 national presentations, as it is conceivable that the former may have a greater underlying interest in academia. Likewise, the same argument may explain why we found that those who took extra time off to complete a sponsored research fellowship were significantly more likely to enter academia, as this extra commitment may reflect a deeper desire for an academic career. A previous study found that participation in the Cloister program (a one year research fellowship associated with the Howard Hughes Medical Institute) increased the likelihood of receiving a faculty appointment with research responsibility at a medical school([6](#_ENREF_6)). Although one might also expect those with additional PhD degrees to be more likely to enter academics, this was not seen in our study, but may be related to the small numbers (6 applicants had PhDs, and 2 of them entered academics).

In this study, the strongest association with an academic job was among those with a clearly stated desire to do so in the personal statement. This factor remained highly significant in both the univariate and multivariate models. In contrast, those stating a desire for private practice rarely entered academics. Only 1 out of the 17applicants stating an outright desire for private practice changed their minds to take an initial academic job. A large number of applicants (n=53) stated a desire to work in an “academic setting.” These applicants typically cite a desire to teach residents, do research without necessarily being academic faculty, or work in a more “stimulating” environment. Although 34% of these applicants did take a full time academic job, they were significantly less likely to do so than those with a clearly stated desire for academics (54% of whom entered academics) and statistically no different than those who were unsure/ no mention (29% of whom entered academics). A limitation of the present study is that we do not know how often applicants wanting an “academic setting” actually did fulfill their stated desires by obtaining teachingroles or performing research projects outside of an academic institution.

Letters of recommendation from colleagues familiar to members of the selection committee are commonly relied upon to assess the true competency of spine fellowship applicants. In our study, comments in the letters were significantly associated with job choice. Letters predicting an academic career proved correct in 47%, and 52% of those being recruited back to their residency institutions actually joined the faculty. Only 2 letters directly stated that the applicant was headed to private practice, but both were correct.

Surprisingly, other than matriculation from a top 20 medical school, most aspects of the academic pedigree, such as college ranking or AOA/ Phi Beta Kappa status, were not associated with an academic job. Although the US News and World Report ranking used in this study is by no means a definitive indicator of the quality of medical school education, the association found in this study may nevertheless reflect the fact that the top medical schools tend to be large, research-oriented institutions with role models for applicants to emulate. The presence of role models has been associated in previous studies with job decision([16](#_ENREF_16), [24-28](#_ENREF_24)). Furthermore, in the present study, applicants from residencies with spine fellowships were more likely to enter academics than those from residencies without spine fellowships (43% versus 30%, p=0.06). Although this difference did not meet significance at the p=0.05 level, the trend likely reflects the effect of positive role modeling by academic spine surgeons on the career aspirations of the applicants from their institutions.

As mentioned previously, job choice is clearly multi-factorial and may be contingent on a variety of factors outside the scope of those listed in a fellowship application. Desire for a certain level of income, family obligations, and geographic constraints may play important roles. Importantly, a desirable academic position may not be available at the time of the job search. In addition, spine fellowship applications have historically been submitted anywhere from 2-3 years before the applicant actually completes the fellowship, providing ample time for a change of mind. The present study also did not examine factors within the fellowship experience itself that may affect job choice, although these could clearly have impact. Finally, this study looked at the initial job taken immediately upon completion of the fellowship rather than the longevity of the applicant’s tenure. An interesting long term study could follow the ultimate career paths of these applicants, but we suspect that long term job associations would more likely be related to external factors, such as the fit and desirability of the jobs themselves, more so than factors contained in the fellowship application.

In conclusion, we found objective factors within spine fellowship applications that are associated with a higher likelihood of taking an academic job. Approximately 50% of those who have completed a sponsored research fellowship, attended a top 20 medical school, had ≥5 national presentations, clearly stated a desire for an academic career in the personal statement, and had a letter of recommendation predicting an academic career or were being recruited back to their residency institution took an academic job upon completion of fellowship. Analyzing these factors may help selection committees evaluate spine fellowship applicants consistent with theacademic missions of their programs.

**1. Abelmann WH, Nave BD, Wilkerson L. Generation of physician-scientists manpower: a follow-up study of the first 294 graduates of the Harvard-MIT Program of Health Sciences and Technology. J Investig Med. 1997 Jun;45(5):272-5.**

**2. Abelson HT, Bowden RA. Women and the future of academic pediatrics. J Pediatr. 1990 May;116(5):829-33.**

**3. Bilbey JH, Fache JS, Burhenne HJ. Are there predictors for future academic radiologists? A Canadian survey. Can Assoc Radiol J. 1992 Oct;43(5):369-73.**

**4. Cain JM, Schulkin J, Parisi V, Power ML, Holzman GB, Williams S. Effects of perceptions and mentorship on pursuing a career in academic medicine in obstetrics and gynecology. Acad Med. 2001 Jun;76(6):628-34.**

**5. Doherty MJ, Schneider AT, Tirschwell DL. Will neurology residents with large student loan debts become academicians? Neurology. 2002 Feb 12;58(3):495-7.**

**6. Fang D, Meyer RE. Effect of two Howard Hughes Medical Institute research training programs for medical students on the likelihood of pursuing research careers. Acad Med. 2003 Dec;78(12):1271-80.**

**7. Feng L, Ruzal-Shapiro C. Factors that influence radiologists' career choices. Acad Radiol. 2003 Jan;10(1):45-51.**

**8. Frieden C, Fox BJ. Career choices of graduates from Washington University's Medical Scientist Training Program. Acad Med. 1991 Mar;66(3):162-4.**

**9. Goldacre M, Lee P, Stear S, Sidebottom E, Richards R. Views of academic dentists about careers in academic dentistry in the United Kingdom. Br Dent J. 2000 Feb 12;188(3):154-9.**

**10. Jackson VA, Palepu A, Szalacha L, Caswell C, Carr PL, Inui T. "Having the right chemistry": a qualitative study of mentoring in academic medicine. Acad Med. 2003 Mar;78(3):328-34.**

**11. Ledley FD, Lovejoy FH, Jr. Factors influencing the interests, career paths, and research activities of recent graduates from an academic, pediatric residency program. Pediatrics. 1993 Sep;92(3):436-41.**

**12. Leonard JC, Ellsbury KE. Gender and interest in academic careers among first- and third-year residents. Acad Med. 1996 May;71(5):502-4.**

**13. Markert RJ, Part HM, Vetter DK. Predictors of careers in academic medicine for graduates of a community-based, primary-care-oriented medical school. Acad Med. 1998 Jul;73(7):790-3.**

**14. McClellan DA, Talalay P. M.D.-Ph.D. training at the Johns Hopkins University School of Medicine, 1962-1991. Acad Med. 1992 Jan;67(1):36-41.**

**15. McGuire LK, Bergen MR, Polan ML. Career advancement for women faculty in a U.S. school of medicine: perceived needs. Acad Med. 2004 Apr;79(4):319-25.**

**16. Prystowsky JH. Factors influencing the pursuit of careers in academic medicine: a survey of MD-PhD residents in dermatology programs in the United States. J Invest Dermatol. 1992 Feb;98(2):125-7.**

**17. Sanders AB, Fulginiti JV, Witzke DB, Bangs KA. Characteristics influencing career decisions of academic and nonacademic emergency physicians. Ann Emerg Med. 1994 Jan;23(1):81-7.**

**18. Sanders AB, Fulginiti JV, Witzke DB. Factors influencing resident career choices in emergency medicine. Ann Emerg Med. 1992 Jan;21(1):47-52.**

**19. Simon SR, Shaneyfelt TM, Collins MM, Cook EF, Fletcher RH. Faculty training in general internal medicine: a survey of graduates from a research-intensive fellowship program. Acad Med. 1999 Nov;74(11):1253-5.**

**20. Dorsey ER, Raphael BA, Balcer LJ, Galetta SL. Predictors of future publication record and academic rank in a cohort of neurology residents. Neurology. 2006 Oct 24;67(8):1335-7.**

**21. Segal S, Lloyd T, Houts PS, Stillman PL, Jungas RL, Greer RB, 3rd. The association between students' research involvement in medical school and their postgraduate medical activities. Acad Med. 1990 Aug;65(8):530-3.**

**22. Brancati FL, Mead LA, Levine DM, Martin D, Margolis S, Klag MJ. Early predictors of career achievement in academic medicine. JAMA. 1992 Mar 11;267(10):1372-6.**

**23. Straus SE, Straus C, Tzanetos K. Career choice in academic medicine: systematic review. J Gen Intern Med. 2006 Dec;21(12):1222-9.**

**24. Hillman BJ, Fajardo LL, Witzke DB, Cardenas D, Irion M, Fulginiti JV. Factors influencing radiologists to choose research careers. Invest Radiol. 1989 Nov;24(11):842-8.**

**25. Hillman BJ, Fajardo LL, Witzke DB, Cardenas D, Irion M, Fulginiti JV. Influences affecting radiologists' choices of academic or private practice careers. Radiology. 1990 Feb;174(2):561-4.**

**26. Reck SJ, Stratman EJ, Vogel C, Mukesh BN. Assessment of residents' loss of interest in academic careers and identification of correctable factors. Arch Dermatol. 2006 Jul;142(7):855-8.**

**27. Rubenstein DS, Blauvelt A, Chen SC, Darling TN. The future of academic dermatology in the United States: report on the resident retreat for future physician-scientists, June 15-17, 2001. J Am Acad Dermatol. 2002 Aug;47(2):300-3.**

**28. Sanders AB. Emergency medicine faculty shortage--the medical school perspective. Ann Emerg Med. 1990 Jul;19(7):826-7.**