Assessment of Arthroscopic Training in U.S. Orthopaedic Surgery Residency Programs: A Resident Self-Assessment

Michael P. Hall, M.D., Kevin M. Kaplan, M.D., Christopher T. Gorczynski, M.D., Joseph D. Zuckerman, M.D., and Jeffrey E. Rosen, M.D.

Abstract
Background: There has been an increasing number of arthroscopic surgeries performed in general orthopaedic surgery practice, as well as a rapid evolution of arthroscopic techniques. The objective of this investigation was to assess the adequacy of arthroscopic training in U.S. orthopaedic residency programs from a resident and program director perspective.

Materials and Methods: The study was performed with a mail-in survey to orthopaedic surgery residents and program directors. Out of 151 programs contacted, we received responses from 24 program directors (15.9%) and 272 residents (11.1% of 2447 possible residents in years 2 through 5 in 2006). Program demographics and resident and program director assessments of arthroscopic surgical training was obtained from the questionnaire. Assessment of open surgical techniques was used as a control. The responses from fifth-year residents (83 of a possible 612 in 2006 (13.6%)) and program directors were used for detailed analysis.

Results: Only 32% (27/83) of fifth-year residents felt there was adequate time dedicated to arthroscopic training, compared to 66% (16/24) of program directors (p < 0.01). Thirty-four percent (28/83) of fifth-year residents felt as prepared in arthroscopy as open techniques, in contrast to 58% (14/24) of program directors, who felt fifth-year residents were appropriately prepared in arthroscopic techniques (p = 0.03). The amount of surgery that residents are allowed to perform correlated significantly (p < 0.01) with confidence levels.

Conclusions: Fifth-year residents who were surveyed felt less prepared in arthroscopic training, compared to open surgical procedures. Program directors surveyed overestimated confidence levels in fifth-year residents performing arthroscopic procedures. To ensure that graduating residents are appropriately prepared for the current demands of a clinical setting, it may be necessary to reexamine residency requirements to ensure adequate practice in developing arthroscopic surgical skills.

Arthroscopy of the knee remains one of the most commonly performed procedures by orthopaedic surgeons in the United States. The American Academy of Orthopaedic Surgeons (AAOS) 2005-2006 Census survey identified arthroscopy as a component of nearly 50% of 13,679 responding surgeons’ practices. A recent American Board of Orthopaedic Surgeons (ABOS) analysis reported the most commonly performed procedures by board examination applicants in 2003. Four of the top six procedures involved knee or shoulder arthroscopy. With the rapid evolution of technology, arthroscopic procedures such as rotator cuff repairs, labral repairs, and ligament reconstructions have become commonplace across the U.S. With the number and complexity of these arthroscopic procedures increasing, there is greater concern regarding the adequacy of arthroscopic training during residency.
The Residency Review Committee for the Accreditation Council of Graduate Medical Education (ACGME) currently does not specify the length or nature of arthroscopic training required during the 5-year orthopaedic surgery residency. Although there has been debate regarding certification, there is no objective testing to evaluate arthroscopic competency at the completion of training. Teaching arthroscopic skills is thought to be inherently more difficult than skills performed in open cases, given the nature of the technique and instrumentation. The setting of arthroscopy requires ambidexterity and sound visual-spatial coordination, as three-dimensional structures are represented in two-dimensional images. Under current work-hour restrictions, residents must now potentially learn these skills with less than optimal operating room time and experience.

The objective of this study was to examine arthroscopic training from the perspectives of both the residents and program directors. We hypothesize that residents do not feel as well trained in arthroscopic surgical techniques as they do for open techniques at the completion of residency training.

Materials and Methods

A survey was conducted to evaluate the opinions of current residents and program directors regarding resident training in arthroscopy. The surveys were mailed to residents (potentially 2447 residents, year 2 through 5) and program directors at 151 programs in February 2006. An email follow-up survey was sent shortly afterward.

The questions included a request for information regarding the characteristics and demographics of the program, current year of training, months of dedicated training in arthroscopy, and months of training to date. Residents were asked to estimate the total number of arthroscopic knee and shoulder cases, as well as open hip, knee, and shoulder cases that they had completed. Questions were then asked regarding various open and arthroscopic hip, knee, and shoulder procedures. These questions evaluated the degree (ranked 1 to 5) to which the participants were allowed to perform the procedure, the confidence they had in performing the procedure independently, and to estimate that confidence compared to a standard primary total knee replacement. The program directors answered questions in reference to their current fifth-year residents.

Statistical methods were applied to responses using the GraphPad INSTAT statistical package (version 3; GraphPad Software, San Diego, California). Analyses were performed with statistical significance defined as p < 0.05.

Results

Out of the 151 programs contacted, we received 296 responses from 42 (27.9%) programs. Responses included 24 program directors (15.9%) and 272 residents (11.1% of a 2447 total of residents, year 2 through 5 in 2006). Twenty-six programs were associated with an academic center, while 16 were considered community programs; there were no military programs. The average number of residents per year in the responding programs was four (range, 2 to 12). Responses were received from 83 (13.6% of 612 in 2006) fifth-year residents. Those surveyed in this study were affected by work-hour restrictions during their third through fifth year. Total responses from program directors and fifth-year residents were used for detailed analysis of the data (Table 1).

Table 1: Mean Fifth-Year Resident Responses (Scaled 0 to 6) with Standard Deviations

<table>
<thead>
<tr>
<th>Arthroscopic Procedure</th>
<th>Degree Allowed to Perform (0-6)</th>
<th>Confidence Performing Alone (0-6)</th>
<th>Confidence Compared to Performing Primary TKA (0-6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnostic</td>
<td>4.75 ± 0.66</td>
<td>4.82 ± 0.52</td>
<td>4.24 ± 0.92</td>
</tr>
<tr>
<td>Loose body removal</td>
<td>4.70 ± 0.73</td>
<td>4.74 ± 0.56</td>
<td>4.09 ± 0.92</td>
</tr>
<tr>
<td>Partial meniscectomy</td>
<td>4.67 ± 0.74</td>
<td>4.69 ± 0.60</td>
<td>4.01 ± 0.96</td>
</tr>
<tr>
<td>Microfracture</td>
<td>4.12 ± 1.12</td>
<td>4.33 ± 0.97</td>
<td>3.73 ± 1.09</td>
</tr>
<tr>
<td>Lateral release</td>
<td>3.76 ± 1.24</td>
<td>3.70 ± 1.08</td>
<td>3.30 ± 1.16</td>
</tr>
<tr>
<td>ACL tunnel creation</td>
<td>3.85 ± 1.02</td>
<td>4.10 ± 0.96</td>
<td>3.23 ± 1.13</td>
</tr>
<tr>
<td>Meniscal repair</td>
<td>3.35 ± 1.39</td>
<td>3.37 ± 1.10</td>
<td>2.65 ± 1.19</td>
</tr>
<tr>
<td>Shoulder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnostic</td>
<td>4.52 ± 1.89</td>
<td>4.55 ± 0.83</td>
<td>3.78 ± 1.13</td>
</tr>
<tr>
<td>Subacromial decompression</td>
<td>4.28 ± 0.97</td>
<td>4.37 ± 0.92</td>
<td>3.52 ± 1.54</td>
</tr>
<tr>
<td>Loose body removal</td>
<td>4.24 ± 1.17</td>
<td>4.29 ± 1.06</td>
<td>3.54 ± 1.20</td>
</tr>
<tr>
<td>Bankart repair</td>
<td>2.94 ± 1.28</td>
<td>3.01 ± 1.26</td>
<td>2.31 ± 1.08</td>
</tr>
<tr>
<td>Arthroscopic knots</td>
<td>3.32 ± 1.47</td>
<td>3.44 ± 1.45</td>
<td>2.68 ± 1.25</td>
</tr>
<tr>
<td>Rotator cuff repair</td>
<td>2.94 ± 1.37</td>
<td>2.93 ± 1.39</td>
<td>2.30 ± 1.19</td>
</tr>
</tbody>
</table>
This is in contrast to only 17% (8/45) of those training 0 to 4 months (p < 0.001; rr = 2.3).

In terms of the volume of arthroscopic knee surgeries, 60% (27/45) of fifth-year residents performing more than 100 cases reported having enough dedicated arthroscopy time. Forty-four percent (20/45) of fifth-year residents performing more than 100 cases felt as prepared with arthroscopy as they did with open procedures. In arthroscopic shoulder surgery, 68% (13/19) of fifth-year residents performing more than 75 cases reported they had enough arthroscopic training, while 47% (9/19) felt as prepared with shoulder arthroscopy as with open procedures.
In comparing those arthroscopic procedures, in which fifth-year residents reported that they were allowed to perform versus those which the director thought they were allowed to perform, there was a significant difference in the following procedures: lateral release, anterior cruciate ligament (ACL) tunnel creation, meniscal repair, Bankart repair, and rotator cuff repair (Fig. 1). Furthermore, in comparing those procedures that fifth-year residents felt confident performing alone versus those that the director thought they could perform alone, there was a significant difference in all the aforementioned procedures except ACL tunnel creation (Fig. 2).

An analysis of individual procedures also provided further insight regarding our hypothesis. Considering arthroscopic rotator cuff repair, 58% (19/33) of fifth-year residents who reported that they were allowed to perform a larger proportion of the procedure (4 and 5 on the survey scale) felt as well trained in arthroscopy, as compared to a primary total knee replacement, 5% (2/38) of those permitted to perform less (1 and 2 on the survey scale) of the procedure felt as well prepared (p < 0.01).

Overall, only 32% (27/83) of fifth-year residents thought there was adequate time dedicated to arthroscopic training, compared to 66% (16/24) of program directors (p < 0.01). Thirty-four percent (28/83) of fifth-year residents felt as prepared in arthroscopy as open techniques (p = 0.03) (Fig. 3). There were no differences observed between academic and community programs.

Discussion

In 1982, Sweeney discussed the difficulty of teaching arthroscopy at the resident level. Over the past two decades, keeping pace with arthroscopic technology has been difficult for practicing orthopaedic surgeons, let alone residents. The learning curve in performing arthroscopic techniques is significant and recently has been demonstrated in arthroscopic rotator cuff repair. Analysis of one surgeon’s first 10 cases demonstrated a mean 80 minutes of additional operative time, when compared to cases 91 through 100. Although a learning curve exists with all surgical procedures, it appears that more experience is necessary to acquire the technical skills and familiarity in performing arthroscopy, as compared to open techniques.

This study supports the hypothesis that graduating orthopaedic residents may not be adequately trained in arthroscopy. The majority of fifth-year orthopaedic residents felt less prepared performing arthroscopic procedures than open procedures, in contrast to the belief of most program directors. Although they felt better prepared with the greater number of arthroscopic cases performed, the proportion of a procedure that residents were allowed to perform was more important than the actual number of cases with which they were involved.

The amount of arthroscopic experience required for adequate resident training is unknown. The only published criteria addressing competence is that of the German Speaking Association of Arthroscopy, which requires 50 diagnostic arthroscopies, 120 partial meniscectomies, and 80 ACL reconstructions to become an instructor. The Arthroscopy Association of North America (AANA) does not specify competence, but requires at least 50 arthroscopic cases per year to maintain active membership. The American Board of Orthopaedic Surgery (ABOS) requires one year of fellowship training in sports medicine and 75 arthroscopic cases in one year to be eligible for subspecialty certification in sports medicine. Interestingly, the AANA has conceded that completion of an orthopaedic residency does not guarantee competence in arthroscopy.

In a recent study from Ireland, Leonard and colleagues surveyed 40 orthopaedic residents and 50 orthopaedic attending surgeons regarding the number of cases it takes to become proficient in four basic arthroscopic knee procedures. They found that estimation by residents and attending surgeons who perform arthroscopy were similar for diagnostic knee arthroscopy (mean 40 vs 45, respectively) and partial medial meniscectomy (mean, 63 vs 70, respectively). However, partial lateral meniscectomy (mean, 90 vs 72, respectively) and ACL reconstructions (mean, 120 vs 90, respectively) were overestimated by residents when compared to attendings. Attendings who did not perform regular arthroscopy, defined as more than 50 cases per year, tended to estimate almost one-half the number of cases required.

O’Neill and coworkers devised a similar survey of U.S. orthopaedic department chairmen and sports medicine fel-
lowship directors. They found a wide variation of opinion in the number of repetitions required to achieve adequate training in five basic arthroscopic procedures. For example, the number of cases for proficiency in arthroscopic partial meniscectomy ranged from eight to 250. Similar to the previous study, those who did not perform regular arthroscopy tended to underestimate the amount of experience needed for proficiency by almost one-half.

The most telling result of the present study was the fact that only one-third of fifth-year residents felt they had adequate arthroscopic training, as opposed to two-thirds of program directors. Program directors repeatedly overestimated the amount of arthroscopy that fifth-year residents were allowed to perform, in addition to their ability to complete these procedures independently. While difficult to compare the assessment of others to self-assessment, this discrepancy represents a possible deficit in resident training worthy of further investigation.

The lack of confidence in arthroscopic techniques may also be a contributing factor to the rising number of orthopaedic surgery residents entering into sports medicine fellowships. In 2007, 155 out of 611 (25.3%) graduating residents took fellowships in sports medicine, compared to 117 of 609 (19.2%) in 2004. Since 1990, the percentage of orthopaedic surgeons with fellowship training in sports medicine has increased from 8.8% to 27.5% in 2006. Given the increasing complexity of arthroscopic techniques, fellowship training may become necessary to perform these procedures in practice.

According to our data, residency curriculums may need to be reevaluated. Many residency programs have now incorporated night float systems to comply with work-hour regulations, further limiting potential time spent in the operating room. Unless hands-on experience in the operating room is increased, residents may be forced to acquire more experience on their own. Increasing resident privileges, however, was recently shown to increase operating room costs, as well as possible lost income for the attending surgeon. Some programs have utilized cadaveric arthroscopy labs to improve arthroscopic skills, but few programs have consistent access to this resource. A possible answer under investigation is virtual reality simulators. Simulators for both knee and shoulder arthroscopy have been created and are currently being evaluated at several large academic centers across the U.S. Although early results appear promising, the ability to provide and standardize this resource across the U.S. will be challenging.

The primary limitation of the present study was its low response rate. It is difficult to propose generalizations about all 151 orthopaedic residency programs; however, our data provides valuable insight into a current discrepancy in the beliefs of residents and program directors. The use of an email-based survey initially may have increased our survey return and should be considered for future study. Although data was collected regarding the number of cases performed and the number of months of training, we acknowledge that it is impossible to draw conclusions secondary to the inherent differences in resident skills and case participation. The lack of data collected regarding the presence of sports medicine fellows and cadaveric arthroscopy labs is another possible limitation. Both could have an effect on resident arthroscopy experience. Finally, as with all surveys, results are based purely on opinion and interpretation is dependent on the accurate reporting of respondents.

In conclusion, the required volume of practice and experience with arthroscopic surgery to become proficient is undefined. According to our results, fifth-year residents feel less prepared in arthroscopic training compared to open procedures, and program directors overestimate confidence levels with arthroscopic techniques. It may be necessary to restructure residency requirements to ensure adequate training in developing arthroscopic surgical skills. Precise definition of these skills is essential, as is an increase in hands-on experience, utilization of cadaveric labs, and virtual reality simulators in order to properly train orthopaedic surgery residents.

Disclosure Statement
None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

References
9. Irani JL, Mello MM, Ashley SW, et al. Surgical residents’ perceptions of the effects of the ACGME duty hour requirements