Educating the future arthroscopic hip surgeon

Ryan P. Coughlin[1*], Olufemi R. Ayeni[1,2*]

[1]Division of Orthopaedic Surgery, Department of Surgery, McMaster University, Hamilton, Ontario, Canada; [2]McMaster University Medical Centre, Hamilton, ON, Canada

Contributions: (I) Conception and design: All authors; (II) Administrative support: All authors; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

*These authors contributed equally to this work.

Correspondence to: Olufemi R. Ayeni. McMaster University Medical Centre, 1200 Main St West, 4E15 Hamilton, Ontario L8N 3Z5, Canada. Email: ayenif@mcmaster.ca.

Abstract: Although hip arthroscopy is one of the fastest growing fields in orthopaedic surgery, formalized education has not been emphasized in most training programs. Unique instrumentation, limited joint access and traction time are some of the factors that hinder trainee involvement in a particularly challenging learning environment. As programs adopt elements of competency-based education, more accurate surrogate markers of trainee performance will be needed. A variety of simulation models have been developed, however, their applications for teaching both technical and non-technical skills in hip arthroscopy remain rudimentary. Future research and development that focuses on valid and reliable teaching and assessment tools that are practical and affordable will be essential to prepare surgeons for independent practice in areas of hip arthroscopy.

Keywords: Hip arthroscopy; arthroscopy; medical education

Received: 08 January 2018; Accepted: 30 January 2018; Published: 02 March 2018.
doi: 10.21037/aoj.2018.01.03
View this article at: http://dx.doi.org/10.21037/aoj.2018.01.03

Introduction

Although arthroscopic procedures are among the most commonly performed surgeries in orthopaedics, they are technically challenging for most learners and difficult for educators to teach (1). Achieving competence in hip arthroscopy is a particularly difficult task for the trainee. In addition to being unaccustomed to the 70-degree arthroscope, the visuospatial orientation is altered due the joint morphology and the need to use multiple portals to improve working access. The limited joint distraction in a highly congruous environment makes maneuverability more difficult, and predisposes the articular cartilage to iatrogenic damage (2). Portal loss is difficult to recover due to the thick muscular envelop, and a deep-seated joint that makes triangulation under fluoroscopic guidance particularly challenging. Lastly, the risk of neuropraxia limits safe duration of traction time and hinders the opportunity for trainee involvement (3).

Metrics of competence in hip arthroscopy

Several studies have been published on the utility of surrogate markers for assessing competence in hip arthroscopy (4-8). One study investigated the effects of formalized instruction and mentorship on learning acquisition by comparing the complication rates from surgeons with and without early career supervision (7). This study retrospectively reviewed the first set of cases performed by a junior surgeon under supervision of a senior surgeon, as well as the same senior surgeon's initial cases in practice without formal supervision. The authors reported lower complication rates with the senior surgeon overseeing the junior hip surgeon (4.9%) compared to the cases initially performed by the senior surgeon without supervised mentorship (7.0%). A systematic review on defining the learning curve in hip arthroscopy identified six studies that looked at the threshold volume of cases that must be performed before reaching a steady-state of proficiency (4). The majority of studies cited 30 cases as the cutoff for reaching advanced level experience. Most of these studies used descriptive statistics, operative time and complication rates as measures of competence. Five of six studies showed improvement in these measures between early and late experience, with only one study proposing an actual learning curve. The authors concluded, however, that there was insufficient evidence to accurately define the learning curve plateau and the rate at which learning is ultimately achieved in hip arthroscopy. A more recent study challenged this level of the learning plateau by finding significantly better clinical outcomes only after a minimum of 100 procedures were performed (5). The authors also found that while portal setup time decreased, the overall surgical time did not. They attributed this discrepancy to the fact that more complex procedures were performed in the later series of included cases. This highlights the limitation with using surgical time to infer learning. Many uncontrolled variables affect the length of an operation, all of which are not under the direct control of the surgeon and scrub team. The total operative time also reflects factors such as, issues with delivering anesthesia, patient positioning, and familiarity of all operating room personnel with the procedure and equipment. Therefore, others have looked to additional ways to define the level of proficiency, using criteria such as the rate of re-operation (revision hip arthroscopy, total hip arthroplasty, hip resurfacing) from time of index procedure (6). This study measured the effect of surgeon career volume on the risk of additional hip surgery after adjusting for patient characteristics. Amongst 8,041 hip arthroscopies performed by 251 surgeons, 989 (12.3%) underwent additional hip surgery within 5 years. Surgeons with the lowest volume [0–97] had the highest frequency of additional surgery (15.4%). The frequencies declined for cases in the middle [98–388], high [38–518] and highest (>519) career volume groups (13.8%, 10.1% and 2.6%, respectively).

Perioperative radiography is an essential tool for diagnosing and treating femoroacetabular impingement (FAI). Radiation exposure during the surgical management of FAI poses health risks to patients and healthcare providers. Thus, awareness of how imaging procedures are associated with radiation exposure may help surgeons improve use of fluoroscopic imaging to lower radiation exposure to more acceptable levels. An online questionnaire designed to determine surgeon knowledge and perspective on radiation safety showed that a majority of hip arthroscopists had a poor understanding about C-arm settings and positions that result in the lowest doses of radiation (9). In the same study, eighty-three surgeons (91.2%) indicated they believed most orthopaedic surgeons need to be more informed about radiation safety. This strongly suggests that further education on the use of fluoroscopy should be included in orthopaedic training programs and continuing education seminars.

Intraoperative fluoroscopy is commonly used for creating portals and assessing cam resection in the peripheral compartment. One study looked at fluoroscopy usage as a surrogate marker for the rate of learning of one surgeon's hip arthroscopy practice (8). The authors showed that the dose of intraoperative radiation and fluoroscopy time decreased significantly over the first 100 cases. However, using fluoroscopy as an indicator of proficiency needs to be interpreted with caution. Fluoroscopy is only used for certain elements of case, and does not reflect the technical ease (or difficulty) of the whole procedure. Lastly, there are multiple factors that can influence the surgical fluoroscopy time (pre-operative advanced imaging, competence of X-ray technologists, and case complexity).

How best to define and evaluate the learning curve remains to be determined. Future research requires well designed prospective studies on surgeons with known baseline abilities, and metrics to determine surgical complexity, and outcome tools that accurately reflect learning acquisition. With an improved understanding of the learning curve for hip arthroscopy, the goal would be to establish guidelines for graduated learning that reflect the number and type of arthroscopic hip procedures one should perform before being considered competent. This could lead to the formation of certification programs or formalized subspecialty fellowships in hip arthroscopy.

The role of competency-based education in hip arthroscopy

There are growing concerns that the traditional time-based training is increasingly inadequate at preparing residents for independent practice. A survey of surgical residents found that 26% of trainees were worried about not feeling confident to operate independently before starting practice (10). Furthermore, senior residents have reported feeling less prepared in arthroscopic surgery compared to open surgical procedures, and expressed concerns that insufficient time is dedicated to arthroscopic education (11). To address this issue, specialty training programs are shifting towards competency-based medical education (CBME). Several medical education competency frameworks have been established, including the Canadian CanMEDS framework (12), the Accreditation Council for Graduate Medical Education (ACGME) Outcomes Assessment Project in the United States (13), and the Intercollegiate Surgical Curriculum Programme (ISCP) in the United Kingdom and Ireland (14). Although CBME is expected to improve postgraduate training, it faces serious challenges, as robust assessment frameworks are needed to provide feedback on performance and guide the development of competence. Many training programs do not have adequate assessment practices built in place, and many trainees currently do not receive meaningful feedback on their clinical rotations (15), which both the Royal College of Physicians and Surgeons of Canada (RCPSC) and ACGME have acknowledged as important issues that need to be addressed.

The ACGME and American Board of Orthopaedic Surgery (ABOS) have recently developed orthopaedic milestones as a new method of assessing resident performance (16). Using this system residents are rated using a five-point scale on designated topics. Residents are expected to reach level 4 by graduation. Milestones assess 16 clinical areas, each of which has a medical knowledge and patient care component. The areas of hip arthroscopy and preservation are not included as clinical areas to be assessed. All departments are required to submit reports to the ACGME on each resident twice a year, but there are no guidelines for how the milestones should be incorporated into trainee evaluation systems. In 2013, 95 of the 102 orthopaedic sports medicine fellowship programs participating in the San Francisco (SF) Match were accredited by the ACGME (17). It is unknown how many of these fellowships offered dedicated time for hip arthroscopy training. The graduation target for ACGME accredited sports fellowships (level 4), is where the fellow is able to surgically treat labral pathology and FAI. However, no minimum number of arthroscopic hip procedures is required to graduate (18). In 2013, the Residency Review Committee (RRC) for orthopaedic surgery suggested a minimum number of certain procedures to compliment the milestones project (19). It is important to note that hip arthroscopy again was not listed as a required procedure. The ACGME has not yet mandated minimal case requirements for graduation. A survey of senior residents attending the American Orthopaedic Association (AOA) resident leadership Forum showed that 67% residents thought case logs were an effective method to evaluate surgical experience, but only 31% thought the ABOS should use specific case log volume as part of the credentialing process (20). Furthermore, resident case volume for particular procedures and self-reported competency have been poorly correlated (21). It is unknown how many hip arthroscopies an average resident performs throughout training. An informal poll of residents from the United States and Canada found, on average, residents participated in 18.4 hip arthroscopies (18). However, it is important to note that the residents questioned were from centers that perform high volumes of hip arthroscopy, and thus the results may be a skewed overrepresentation, and not reflective of most training programs.

The most commonly used examination to objectively assess resident knowledge in North America is the Orthopaedic In-Training Examination (OITE) administered by the American Academy of Orthopaedic Surgeons (AAOS) (22). This exam covers 12 categories in orthopaedics. While performance on the OITE correlates with successful completion of the ABOS part 1 examination (23), it does not necessarily correlate with residents' overall subjective performance in clinical and surgical rotations (24). Furthermore, the OITE does not address hands-on surgical skills. A study recently compared resident and program director (PD) perspectives on the value of the In-Training examination, as well as, current resident study habits and ideal study strategies (25). Residents were less likely to agree that the OITE was a valuable measure of their orthopaedic knowledge. They also felt that online-based practice resources, and rotations in a given subspecialty were more valuable methods of OITE preparation than did PDs. Peters *et al.*, in a panel discussion by hip preservation experts, reported that: "*Diagnosis and management of young adult hip deformities frequently are not formally covered in sports medicine or adult reconstruction curricula*" (26). A study analyzing the actual weight of the sports medicine section of the OITE found it to represent 7.8% of the exam (27). When topic content within the sports medicine section was broken down, knee (42.5%), shoulder (16.0%), and medically related (13.2%) questions constituted an overwhelming majority of tested topics, including 15% of the total questions being focused on the anterior cruciate ligament. Interestingly, hip related topics, including FAI diagnosis represented only 6.6% (1.4 questions per year) of all sports medicine related content tested. This number may be slightly understated as some FAI questions may be cross-covered in other sections, such as hip reconstruction.

Nevertheless, there is less incentive for residents to focus their efforts preparing for questions relating to the field of hip arthroscopy.

Simulation in hip arthroscopy

In response to resident work-hour restrictions, concerns over patient safety and reduced training time in the operating room, teaching and assessing surgical skills using simulation has become more commonplace. The ABOS and RRC of the Accreditation Council for Graduate Medical Education recently approved mandates to implement surgical simulation training in all orthopaedic residency programs (28). The surgical task force developed a structured educational curriculum consisting of seventeen simulation modules. While these tasks are designed to improve arthroscopic dexterity and hand-eye coordination, none of the modules focus on skills unique to hip arthroscopy.

Various types of simulators have been developed ranging from dry benchtop (BT) models to high-fidelity virtual reality (VR) simulators. Studies in other subspecialties have shown no difference in the performance and learning of surgical skills between high and low fidelity models (29). Unfortunately, simulation in hip arthroscopy is still in its infancy. A recent systematic review on arthroscopic simulation found a total of 14 studies, of which five assessed simulated knee arthroscopy, eight assessed shoulder arthroscopy, and only one study assessed simulated hip arthroscopy (30). One study comparing arthroscopic VR and bench top knee models showed that training on each simulator resulted in significant improvement in performance metrics (31). Interestingly, BT training conferred a significant improvement in all parameters when trainees were reassessed on the VR simulator. In contrast, VR training did not confer improvement in performance when trainees were reassessed on the BT simulator. In another study comparing groups that had trained on both VR and bench top simulators, the VR post-training subjects consistently outperformed the bench-top model group in a simulated cadaveric knee setup (32). These studies suggest that there are differences in skills acquired on different simulators, and skills learnt on some types of simulators may be more transferable. Howells *et al.* have shown transfer validity of arthroscopic skills from a BT knee simulator to the operating room (33). Cannon *et al.* showed similar transfer validity of skills gained on a high-fidelity VR knee simulator to the operating room (34). To date, no such study has been performed with regards to hip arthroscopy.

One study that assessed diagnostic hip arthroscopy using a VR simulator found that the expert group outperformed the novice group with respect to time to task completion, and the number of collisions with bone and soft tissues (35). A more recent study evaluated more complex arthroscopic tasks that included repair of labral tissue on a dry hip model (36). Participants were evaluated using a task-specific checklist, the Arthroscopic Surgical Skill Evaluation Tool (ASSET), task completion time, and a final global rating scale. A difference between participants based on the level of training and exposure to previous arthroscopic procedures was found.

Given the paucity of arthroscopic simulators accessible to trainees, it would be helpful to determine whether learning simulation-based arthroscopic skills in one anatomical joint environment can immediately transfer learnt skills to another joint. One study randomized novice trainees to practice for a period of time on either knee or shoulder BT models (37). While all participants demonstrated learning acquisition from initial assessment, there was no immediate evidence of skill transfer when they switched to the unfamiliar anatomical joint environment. These findings have important clinical implications with regard to surgical training as they challenge the assumption that basic arthroscopic skills acquired in one joint are universally transferrable to other joints, and further emphasizes the importance of more dedicated hip simulation options.

As the trend shifts towards using simulation as an adjunct to the traditional proctorship model, limited program resources continue to be a major hurdle to widespread adoption. In the United States, it has been estimated that 25% of training programs still do not have a dedicated simulation facility, and 87% of training programs report a lack of sufficient funds as the main barrier (38). One low cost strategy to enhance learning is called cognitive task analysis (CTA) (39). CTA allows experts to provide complex information to trainees in a logical and efficient manner, which makes it easier to comprehend, visualize and deconstruct procedural steps (40). It has been extensively used to train pilots, professional musicians and the military population, and has been shown to improve performance of Olympic athletes (41). One study was designed to assess the effectiveness of CTA as an innovative adjunct to teaching diagnostic knee arthroscopy (42). In this study, 16 novice residents were either split to receive the CTA tool or were provided no additional learning material. Both groups' performance was assessed objectively on a BT knee simulator. The results showed a significant improvement in the ASSET score and task completion scores for the trainees who used CTA compared to the control group. While CTA appears to show potential to improve simulated performance, including precision, accuracy, and reducing operative errors, its applications in the domain of hip arthroscopy remains untested.

Lastly, what must not be forgotten are the ever so important non-technical skills. The cornerstone for successful outcomes in hip arthroscopy are proper history taking and focused physical examination. Some surgical fields have started adopting the Objective Structured Clinical Examination (OSCE) to help train residents in areas of critical thinking and decision-making processes, both of which are intimately related to formulating indications and patient selection (43). This approach may prove to be particularly useful for hip arthroscopy where multiple variables including overlapping musculoskeletal and organ systems, and psychosocial aspects often escalate the patients perceived pain and dysfunction or distract the clinician from what is relevant.

Conclusions

Several studies have reported longer operating times, higher re-operation and complication rates with the inexperienced hip surgeon. However, it is important to emphasize that these are only crude estimates of actual surgeon competence. In an era of increasing surgical specialization, higher rates of malpractice claims, and reimbursement tied to quality-based patient outcomes, improved methods of measuring and obtaining competency are needed. The use of simulation techniques for both instruction and assessment are fundamental to modern surgical education. They provide opportunities to practice in a risk-free environment and their use has been shown to be helpful in assessing, maintaining, and expanding on technical and non-technical skills. As hip preservation and arthroscopy fellowships continue to grow, valid and reliable teaching and assessment tools that are practical and affordable will be essential to prepare surgeons for future practice.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Annals of Joint* for the series "Future Perspectives in Hip Preservation and Arthroscopy". The article has undergone external peer review.

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/aoj.2018.01.03). The series "Future Perspectives in Hip Preservation and Arthroscopy" was commissioned by the editorial office without any funding or sponsorship. RPC served as the unpaid Guest Editor of the series. ORA served as the unpaid Guest Editor of the series and serves as an unpaid editorial board member of *Annals of Joint* from Aug 2017 to Jul 2019. ORA reports that he is a member of the Speakers bureau for Conmed. The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Garrett WE, Swiontkowski MF, Weinstein JN, et al. American Board of Orthopaedic Surgery practice of the orthopaedic surgeon: Part-II, certification examination case mix. J Bone Joint Surg Am 2006;88:660-7.
2. McCarthy JC, Lee JA. Hip arthroscopy: indications, outcomes, and complications. Instr Course Lect 2006;55:301-8.
3. Habib A, Haldane CE, Ekhtiari S, et al. Pudendal nerve injury is a relatively common but transient complication of hip arthroscopy. Knee Surg Sports Traumatol Arthrosc 2018;26:969-75.
4. Hoppe DJ, de Sa D, Simunovic N, et al. The learning curve for hip arthroscopy: a systematic review. Arthroscopy 2014;30:389-97.
5. Kautzner J, Zeman P, Stančák A, et al. Hip arthroscopy

learning curve: A prospective single-surgeon study. Int Orthop 2017. [Epub ahead of print].
6. Nawabi DH, Mehta N, Chamberlin P, et al. Learning curve for hip arthroscopy steeper than expected. J Hip Preserv Surg 2016;3:1.
7. Dietrich F, Ries C, Eiermann C, et al. Complications in hip arthroscopy: Necessity of supervision during the learning curve. Knee Surg Sports Traumatol Arthrosc 2014;22:953-8.
8. Smith KM, Duplantier NL, Crump KH, et al. Fluoroscopy learning curve in hip arthroscopy—A single surgeon's experience. Arthroscopy 2017;33:1804-9.
9. Saroki A, Wijdicks C, Philippon M, et al. Orthopaedic surgeons' use and knowledge of ionizing radiation during surgical treatment for femoroacetabular impingement. Knee Surg Sports Traumatol Arthrosc 2016;24:3962-70.
10. Bucholz EM, Sue GR, Yeo H, et al. Our trainees' confidence: Results from a national survey of 4136 US general surgery residents. Arch Surg 2011;146:907-14.
11. Hall MP, Kaplan KM, Gorczynski CT, et al. Assessment of arthroscopic training in U.S. orthopedic surgery residency programs--a resident self-assessment. Bull NYU Hosp Jt Dis 2010;68:5-10.
12. Frank JR, Langer B. Collaboration, communication, management, and advocacy: Teaching surgeons new skills through the CanMEDS Project. World J Surg 2003;27:972-8.
13. Swing S. ACGME launches outcomes assessment project. JAMA 1998;279:492.
14. McKee RF. The Intercollegiate Surgical Curriculum Programme (ISCP). Surgery 2008;26:411-6.
15. Ahmed M, Sevdalis N, Vincent C, et al. Actual vs perceived performance debriefing in surgery: Practice far from perfect. Am J Surg 2013;205:434-40.
16. Swing SR, Beeson MS, Carraccio C, et al. Educational milestone development in the first 7 specialties to enter the next accreditation system. J Grad Med Educ 2013;5:98-106.
17. Daniels AH, Grabel Z, DiGiovanni CW. ACGME accreditation of orthopaedic surgery subspecialty fellowship training programs. J Bone Joint Surg Am 2014;96:e94.
18. Ayeni OR, Karlsson J, Philippon M, et al. editors. Diagnosis and Management of Femoroacetabular Impingement: An Evidence-Based Approach. Berlin: Springer, 2017.
19. Accreditation Council for Graduate Medical Education (ACGME). Orthopaedic surgery minimum numbers. Available online: https://www.acgme.org/Portals/0/PFAssets/ProgramResources/260_ORS_Case_Log_Minimum_Numbers.pdf
20. Jeray KJ, Frick SL. A survey of resident perspectives on surgical case minimums and the impact on milestones, graduation, credentialing, and preparation for practice: AOA critical issues. J Bone Joint Surg Am 2014;96:e195.
21. Safavi A, Lai S, Butterworth S, et al. Does operative experience during residency correlate with reported competency of recent general surgery graduates? Can J Surg 2012;55:S171-7.
22. Nattress LW. Orthopaedic in-training examination. J Med Educ 1969;44:878-89.
23. Swanson D, Marsh JL, Hurwitz S, et al. Utility of AAOS OITE scores in predicting ABOS Part 1 outcomes: AAOS exhibit selection. J Bone Joint Surg Am 2013;95:e84.
24. Lackey WG, Jeray KJ, Tanner S. Analysis of the musculoskeletal trauma section of the orthopaedic in-training examination (OITE). J Orthop Trauma 2011;25:238-42.
25. Camp CL, Degen RM, Hanssen AD, et al. Residents and program director perspectives often differ on optimal preparation strategies and the value of the orthopedic in-training examination. J Surg Educ 2018;75:164-70.
26. Peters CL, Beaulé PE, Beck M, et al. Report of breakout session: Strategies to improve hip preservation training. Clinical Orthopaedics and Related Research 2012;470:3467-9.
27. Osbahr DC, Cross MB, Bedi A, et al. Orthopaedic in-training examination: An analysis of the sports medicine section. Am J Sports Med 2011;39:532-7.
28. American Board of Orthopaedic Surgery. ABOS Surgical Skills Modules for PGY-1 Residents. Available online: https://www.abos.org/abos-surgical-skills-modules-for-pgy-1-residents.aspx. Accessed 2014 Sep 6.
29. Matsumoto ED, Hamstra SJ, Radomski SB, et al. The effect of bench model fidelity on endourological skills: A randomized controlled study. J Urol 2002;167:1243-7.
30. Tay C, Khajuria A, Gupte C. Simulation training: A systematic review of simulation in arthroscopy and proposal of a new competency-based training framework. Int J Surg 2014;12:626-33.
31. Middleton RM, Alvand A, Garfjeld RP, et al. Simulation-based training platforms for arthroscopy: A randomized comparison of virtual reality learning to benchtop learning. Arthroscopy 2017;33:996-1003.
32. Banaszek D, You D, Chang J, et al. Virtual reality compared with bench-top simulation in the acquisition of arthroscopic skill: A randomized controlled trial. J Bone

Joint Surg Am 2017;99:e34.
33. Howells NR, Gill HS, Carr AJ, et al. Transferring simulated arthroscopic skills to the operating theatre: A randomized blinded study. J Bone Joint Surg Br 2008;90:494-9.
34. Cannon WD, Garrett WE, Hunter RE, et al. Improving residency training in arthroscopic knee surgery with use of a virtual-reality simulator. J Bone Joint Surg Am 2014;96:1798-806.
35. Khanduja V, Lawrence JE, Audenaert E. Testing the construct validity of a virtual reality hip arthroscopy simulator. Arthroscopy 2017;33:566-71.
36. Phillips L, Cheung JJH, Whelan DB, et al. Validation of a dry model for assessing the performance of arthroscopic hip labral repair. Am J Sports Med 2017;45:2125-30.
37. Ferguson J, Middleton R, Alvand A, et al. Newly acquired arthroscopic skills: Are they transferable during simulator training of other joints? Knee Surg Sports Traumatol Arthrosc 2017;25:608-15.
38. Karam MD, Pedowitz R, Natividad H, et al. Current and future use of surgical skills training laboratories in orthopaedic resident education: A national survey. J Bone Joint Surg Am 2013;95:e4.
39. Militello LG, Hutton RJ. Applied cognitive task analysis (ACTA): A practitioner's toolkit for understanding cognitive task demands. Ergonomics 1998;41:1618-41.
40. Wingfield LR, Kulendran M, Chow A, et al. Cognitive task analysis: Bringing olympic athlete style training to surgical education. Surg Innov 2015;22:406-17.
41. Suinn RM. Mental practice in sport psychology: Where have we been, where do we go? Clin Psychol Sci Pract 2006;4:189-207.
42. Bhattacharyya R, Davidson DJ, Sugand K, et al. Knee arthroscopy simulation: A randomized controlled trial evaluating the effectiveness of the imperial knee arthroscopy cognitive task analysis (IKACTA) tool. J Bone Joint Surg Am 2017;99:e103.
43. Franzese C. When to cut? Using an objective structured clinical examination to evaluate surgical decision-making. Laryngoscope 2007;117:1938-42.

doi: 10.21037/aoj.2018.01.03
Cite this article as: Coughlin RP, Ayeni OR. Educating the future arthroscopic hip surgeon. Ann Joint 2018;3:13.