ORIGINAL ARTICLE

Teaching for the Transition: the Canadian PGY-1 Neurosurgery 'Rookie Camp'

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ABSTRACT: ***Background***: Transitioning from medical school to residency is difficult and stressful, necessitating innovation in easing this transition. In response, a Canadian neurosurgical Rookie Camp was designed and implemented to foster acquisition of technical, cognitive and behavioral skills among incoming Canadian post graduate year one (PGY-1) neurosurgery residents. ***Methods***: The inaugural Rookie Camp was held in July 2012 in Halifax. The curriculum was developed based on a national needs-assessment and consisted of a pre-course manual, 7 case-based stations, 4 procedural skills stations and 2 group discussions. The content was clinically focused, used a variety of teaching methods, and addressed multiple CanMEDS competencies. Evaluation included participant and faculty surveys and a pre-course, post-course, and 3-month retention knowledge test. ***Results:*** 17 of 23 PGY-1 Canadian neurosurgical residents participated in the Camp. All agreed the course content was relevant for PGY-1 training and the experience prepared them for residency. All participants would recommend the course to future neurosurgical residents. A statistically significant improvement was observed in knowledge related to course content ($F_{(2,32)} = 7.572$, $p < 0.002$). There were no significant differences between post-test and retention-test scores at three months. ***Conclusion:*** The inaugural Canadian Neurosurgery Rookie Camp for PGY-1 residents was successfully delivered, with engagement from participants, training programs, the Canadian Neurosurgical Society, and the Royal College. In addition to providing fundamental knowledge, which was shown to be retained, the course eased junior residents' transition to residency by fostering camaraderie and socialization within the specialty.

RÉSUMÉ: Enseignement pour faciliter la transition : le « camp-école » canadien PGY-1 en neurochirurgie. ***Contexte:*** La transition de l'école de médecine à la résidence est difficile et stressante et nécessite qu'on fasse appel à l'innovation pour faciliter cette transition. C'est pourquoi un camp-école a été conçu et mis en place pour favoriser l'acquisition d'habiletés techniques, cognitives et comportementales chez les récents gradués se destinant à la résidence en neurochirurgie (post graduate year one – PGY-1). ***Méthode:*** Le premier camp-école a eu lieu en juillet 2012 à Halifax. Le curriculum a été développé à partir d'une évaluation nationale des besoins et comportait un manuel préparatoire, 7 stations basées sur des cas, 4 stations sur des habiletés procédurales et 2 discussions en groupe. Le contenu ciblait la clinique, utilisait différentes méthodes d'enseignement et faisait appel à de multiples compétences CanMEDS. Le programme a été évalué au moyen d'enquêtes auprès des participants et des enseignants ainsi que par un test d'évaluation des connaissances avant le cours, après le cours et de rétention 3 mois plus tard. ***Résultats:*** Dix-sept des 23 résidents Canadiens de niveau PGY-1 en neurochirurgie ont participé au camp-école. Tous étaient d'accord sur la pertinence du contenu du cours à la formation des résidents de niveau PGY-1 et ils ont rapporté que l'expérience les avait préparés à la résidence. Tous recommanderaient le cours aux futurs résidents en neurochirurgie. Une amélioration des connaissances acquises, qui était significative au point de vue statistique, a été observée ($F(2,32) = 7,572$; $p < 0,002$). Nous n'avons pas observé de différence significative quant à la rétention, selon les scores aux tests effectués après le cours et trois mois plus tard. ***Conclusion:*** Le premier camp-école canadien pour les résidents de niveau PGY-1 en neurochirurgie a été un succès, grâce à une implication des participants, des programmes de formation, de la Société canadienne de neurochirurgie et du Collège Royal. En plus de fournir des connaissances fondamentales, que les participants ont retenues, le cours a facilité la transition des résidents juniors à la résidence en favorisant la camaraderie et la socialisation au sein de la spécialité.

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The transition from medical school to residency can be abrupt and stressful. The start of post-graduate training is associated with substantive changes in professional independence, as trainees take on greater responsibility in managing complex, acutely ill patients.[1-3] These challenges are exacerbated by the wide variability in clinical knowledge and skills among graduating medical students,[1,2,4-6] some of whom candidly express a lack of self-confidence in their abilities.[1,3,7] As a result, at the onset of residency, trainees may experience increased stress and burnout

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and may even inadvertently commit errors that compromise patient care.[2,8,9] Although this is often mitigated through the experience residents accumulate during training, until this occurs the potential for negative consequences remains high. In fact, recent evidence demonstrates an increase in mortality attributable to medical error in the months when medical graduates begin residency training, suggesting the anecdotal "July Effect" may be a real phenomenon.[10] The potential implications of such errors are magnified in high acuity fields like neurosurgery. However, present day post-graduate surgical education is characterized by duty hour restrictions, fiscal constraints, and complexity of surgical care that limit opportunities for skills training in the clinical setting.[11]

The undeniable concern for patient safety, coupled with the perceived lack of preparedness among incoming post-graduate trainees, provides a strong rationale for developing programs to ease this transition. In 2012, the Association of Faculties of Medicine in Canada (AFMC), in partnership with the Royal College of Physicians and Surgeons of Canada (Royal College) and other stakeholders, released the Future of Medical Education in Canada Post Graduate (FMEC-PG) project report. One of its recommendations is to ensure effective transitions "along the educational continuum",[12] including the transition from undergraduate to postgraduate training. As a key transformative action, the report calls for development of pan-Canadian resident orientation programs to standardize entry into residency training.[12]

The Canadian Neurosurgery Rookie Camp was launched in July 2012, as a first step in addressing these recommendations. In keeping with similar surgical orientation programs,[13-15] the goal of the Camp was to foster acquisition of basic technical, cognitive and behavioural neurosurgical skills, so that incoming residents could begin post-graduate training with increased clinical proficiency and self-confidence. Details of the development, delivery and evaluation of the inaugural Rookie Camp are presented in this report.

Methods

Curriculum Development and Course Delivery

The concept of a national neurosurgery training camp was presented (by author DBC) to the Royal College neurosurgery specialty training committee and endorsed in November 2011. Following this, a multidisciplinary organizing committee was convened to develop the curriculum and evaluation plan for the Rookie Camp. The committee included Canadian neurosurgery program directors, faculty, and residents; medical educators; simulation experts; and representatives from the Royal College. The committee developed educational objectives using the Royal College Objectives for Training in Neurosurgery and the CanMEDS competency Framework[16] (Appendix 1) and course content based on a review of existing surgical orientation programs (e.g. the Society of Neurological Surgeons "bootcamp" course[13]) and a national needs-assessment survey (see Brandman et al. in this issue).

The inaugural Rookie Camp was held in July 2012 at the Dalhousie University Skills Centre for Health Sciences (Halifax, Nova Scotia). Post-graduate year one (PGY-1) residents from all Canadian neurosurgical training programs were invited to participate. Funding for registration, materials, and meals was provided through unrestricted educational grants. All materials donated by corporate partners were deemed necessary to meet course objectives.

A pre-course manual was distributed electronically before the Camp and in print on the first day. Residents attended a social event the evening before the course began, while course faculty attended a session on delivering effective feedback. All faculty and participants attended a second social gathering on the evening of the second day. During the two-day course, groups of three to four participants rotated through multiple stations, each of which was facilitated by one or two faculty members. During the seven 'case-based' stations, relevant aspects of a patient's history, physical exam, differential diagnosis and management were reviewed, followed by demonstration of relevant anatomy and surgical approaches using imaging and cadavers, and finally experiential skills training using various simulation modalities (Figure 1). An additional four procedural skills stations featured faculty modeling of appropriate surgical technique for various basic skills, after which participants practiced using part-task training exercises (Figure 2). During emergency management, team training and communication skills stations, residents participated in immersive simulations combining role-play and high-fidelity mannequins, with subsequent debriefing by simulation educators (Figure 3). A detailed summary of these course activities is provided in Table 1.

Program Evaluation

The Rookie Camp was evaluated by surveying participants and faculty, who rated their agreement with statements pertaining to each station and the course overall on a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree). In addition, participants and faculty were invited to provide additional free-text comments regarding their experiences. The impact of the course on participants' knowledge was evaluated using three multiple-choice tests: a pre-test held at the beginning of the first day of the course, post-test held at the end of the second day, and a retention-test conducted three months after the Camp (administered electronically using the Royal College learning management system). The tests contained two to three questions from each station ("taught" questions), as well as four questions on topics not covered in the course ("not taught" questions). The organizing committee reviewed each question to ensure accuracy and an appropriate level of difficulty. Further validity or reliability testing was not conducted.

Data Analysis

Statistical analyses were performed using SPSS 21 (IBM Corp, Armonk, NY). Results from the surveys were analyzed using descriptive summaries (median, range and frequency of each Likert response). Raw scores on the knowledge tests were converted to percentages and analyzed using one-way repeated measures analysis of variance with post-hoc pairwise comparisons using the Bonferroni correction for normally distributed variables, and the Friedman test for non-normal distributions. Separate analyses were conducted for overall test scores, scores on "taught" questions, and scores on "not-taught" questions.

Results

Seventeen of 23 PGY-1 residents (74%) attended the inaugural Rookie Camp, representing 11 of 14 (79%) Canadian neurosurgical training programs. The regional distribution of residents attending the Camp is shown in Figure 4. All participants

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Figure 1: *Case-based stations*
To contextualize course content, participants rotated in small groups through stations focused on a clinical case. After discussion of case history and physical exam findings, relevant anatomy and surgical approaches were reviewed using imaging and/or pre-dissected cadavers (A, B). Additional time was given to review the appropriate use of surgical instruments (C) and relevant cranial and spinal surface anatomy either during the case or during Case 11 (Craniotomy and Neurosurgical Instruments 101). Finally, time was given for technical skills practice relevant to the scenario using a variety of high and low-fidelity training models, e.g. placement of a real halo ring and vest on a mannequin during the spinal cord injury case (D).

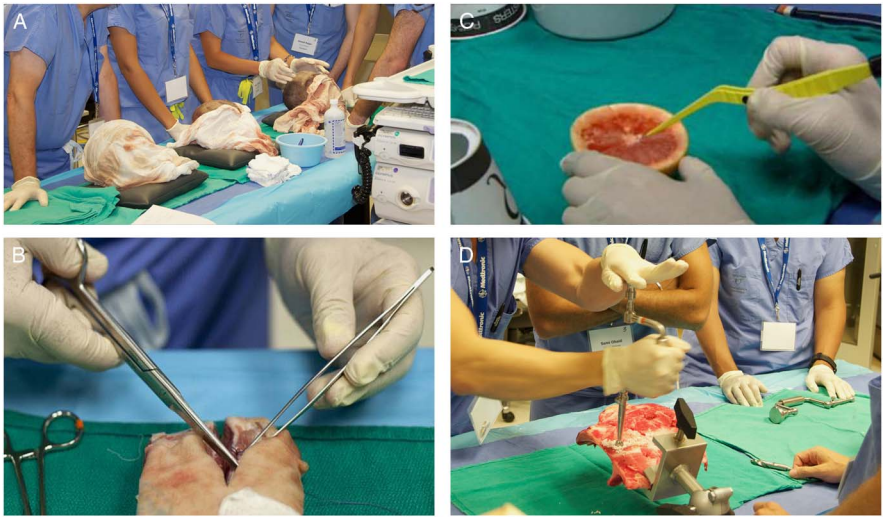

Figure 2: *Procedural skills training stations*
Trainees had the opportunity to engage in deliberate practice of basic neurosurgical skills during the procedural skills stations, which utilized both high and low-fidelity part-task training models. A variety of basic neurosurgical technical skills and procedures were reviewed, including: landmarking and inserting external ventricular drains using a cadaver (A); two-layer scalp closure simulated using pork-belly (B); principles of hemostasis and use of bipolar cautery using grapefruit and/or sand (C); and placing a burrhole using handheld and pneumatic perforators on sheep scapulae (D).

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Figure 3: *High fidelity simulation*
Trainees are presented with a case of traumatic head injury (A). After triaging the case over the telephone and discussing transfer of the patient with a simulated physician from a peripheral hospital (B), residents have the opportunity to manage the patient (via a high-fidelity mannequin) in small groups. The residents' management of the case, team dynamics, and communication skills are debriefed following the scenario (C-D).

received the pre-course manual and participated in the entirety of the course.

Resident and Faculty Course Evaluations

The results of both participant and faculty evaluations are summarized in Table 2, with detailed comments provided in Appendix 2. Between 13 and 17 (76-100%) station-specific and overall course evaluations were completed by participants. All respondents agreed that the stated objectives were met and sufficient time was allotted for skills training in each station. With the exception of the hemostasis module (Station 9), respondents agreed that the information presented was relevant and valuable for the PGY-1 level.

Of the case-based stations, respondents rated Case 2 (posterior fossa tumour with hydrocephalus, which included external ventricular drain (EVD) insertion) highest with respect to training relevance. Participants found the opportunity to practice EVD insertion using real instruments useful, and one participant stated, "… it was very helpful to learn strategies for breaking bad news." Similar ratings were observed for cases 6 (pituitary tumour with endonasal navigation), 4 (cauda equina), 1 (subarachnoid hemorrhage and shunt tapping), and 5 (spinal cord injury with halo application). Participants again found the exposure to new topics (e.g. halo application) and the opportunity to learn communication strategies helpful. With respect to procedural skills, station 10 (basic surgical skills) was rated highest, with 93% of respondents strongly agreeing that the skills learned were relevant, practical and valuable for their training. Conversely, the virtual reality bimanual hemostasis training station (station 9) was rated lowest.

The overall course evaluation revealed that for the majority of participants, the content of the course was novel. In addition, all participants agreed that the location of the Camp was appropriate, the knowledge and skills taught were relevant and the content was taught in a comprehensive manner. In particular, many trainees found the pre-course manual and small group-learning format to be beneficial. One participant noted that simulations afforded the opportunity to "work under pressure [and] to see what it is like before it happens on the floor." Notably, 100% of respondents strongly agreed that they would implement what they learned in clinical practice and that they would recommend the course to future neurosurgery residents. Course faculty echoed these sentiments, commenting: "this course exceeded my expectations; I did not think it would work out this well and be as well received."

Both participants and faculty also provided suggestions for improvement. In particular, participants requested additional teaching on interpretation of imaging (particularly spinal comuted tomography and magnetic resonance imaging), more anatomical dissection, a larger variety of examples (e.g. during the consent discussion) and more time for individual practice of technical skills (e.g. mounting a halo, inserting an EVD, etc.). In addition, both participants and faculty suggested limiting cases to less than 1.5 hours. Faculty suggested adding various technical and clinical skills, such as high-speed drilling, an introduction to the operating microscope, and observed neurological exam of a comatose and awake patient (using a standardized patient) with faculty feedback. Both residents and faculty found the virtual-reality simulation less useful than other aspects of the course.

Knowledge Test Results

The results of the pre-, post-, and three-month retention tests are presented in Figure 5. A significant increase in the percentage of correct responses was observed for overall test scores ($F_{(2,32)} = 8.092$, $p < 0.01$) and on questions concerning material taught during the course ($F_{(2,32)} = 7.572$, $p < 0.002$), but not for material not taught during the course ($\chi^2_{(2)} = 1.302$, $p < 0.521$).

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Table 1: Summary of Rookie Camp Curriculum

Group discussion sessions:		
Case[a]	**Skills taught**	**Educational methods**
1. Spontaneous subarachnoid hemorrhage (SAH)	**Cognitive:** interpretation of a cranial CT; initiating management of a patient with aneurysmal SAH; hyponatremia; hydrocephalus requiring CSF diversion; shunt infection/ obstruction **Behavioural:** presentation of the case to a senior resident (CanMEDS communicator and collaborator role) **Technical:** pterional craniotomy positioning, cranial landmarks, incision, bone flap location and cortical anatomy; VP shunt landmarks, insertion techniques, valves, shunt mechanics; tapping a VP shunt	Small group learning (case-discussion); Expert demonstration (pterional craniotomy on a cadaver); Role play (case presentation); Part-task training (tapping a shunt)
2. Posterior fossa tumour with obstructive hydrocephalus	**Cognitive:** interpretation of a cranial CT; **Behavioural:** breaking bad news about a patient's malignant brain tumour (CanMEDS communicator role) **Technical:** suboccipital craniotomy positioning, landmarks, incision, bone flap, and cortical anatomy; EVD insertion; management of a blocked EVD	Small group learning (case-discussion); Expert demonstration (suboccipital craniotomy on cadaver); Role play (breaking bad news); High fidelity simulation (EVD insertion on a cadaver using bedside EVD kit)
3. Cranial trauma/ Epidural hematoma (EDH)	**Cognitive:** taking a neurological history and physical exam in a comatose patient, management of acute cranial trauma; 3rd nerve palsy; post-op management of raised intracranial pressure **Behavioural:** triaging referrals from peripheral hospitals; team communication in initial management of EDH, ensurng patient safety (CanMEDS health advocate, collaborator and manager role) **Technical:** trauma craniotomy positioning, landmarks, exposure, anatomy	Didactic teaching (communication frameworks); Expert demonstration (trauma craniotomy on a cadaver); Role play (telephone simulation of referral); High fidelity simulation (team management of a patient with acute EDH and blown pupil in an emergency room setting)
4. Cauda equina	**Cognitive:** neurological history and physical exam, differentiating mechanical and radicular back/neck pain, interpretation of spinal MRI **Behavioural:** obtaining informed consent (CanMEDS communicator role) **Technical:** approach to lumbar discectomy (positioning, exposure, anatomy)	Small group learning (case-discussion); Didactic lecture (approach to discectomy); Role play (obtaining informed consent from a patient);
5. Spinal cord injury (SCI)	**Cognitive:** interpretation of spinal XR, CT and MRI; initial evaluation and management of acute SCI **Behavioural:** communicating effectively during handover (CanMEDS communicator role) **Technical:** cervical traction and halo application	Small group learning (case-discussion); Role play (handover after a call shift); High-fidelity simulation (halo application on a mannequin in a team-setting)
6. Pituitary tumour with decreasing vision	**Cognitive:** interpretation of a cranial MRI, initial management of pituitary tumour/apoplexy, **Behavioural:** communicating emergent case to attending (CanMEDS communicator and collaborator role) **Technical:** basic use of endoscopy for cranial navigation, anatomical landmarks in transsphenoidal approach to anterior skull base	Small group learning (case-discussion); Expert demonstration (endoscopic endonasal approach on a cadaver); Role play (case presentation); High fidelity simulation (appropriate handling of endoscope and endonasal navigation on a cadaver)
7. Status epilepticus	**Cognitive:** recognition of a seizure, patient safety during a seizure, recognition and management of status epilepticus	Large group discussion (recognition and management of a patient in status)
Procedural Skills Stations:		
8. Lumbar CSF Access	**Technical:** lumbar puncture, lumbar drain insertion	- Part-task training using a simulated lumbar torso and real lumbar puncture/drain kit
9. Principles of hemostasis	**Technical:** bimanual control of hemorrhage using suction/bipolar cautery, coagulation of vessels	- Virtual reality simulation (NeuroTouch hemostasis module)
10. Basic surgical skills	**Technical:** sterile technique for prepping and draping, appropriate technique for bipolar cautery, suturing and knot tying for scalp closure	- 'Low-fidelity' simulation (part-task training using pig-skin for layered scalp closure, grapefruit for bipolar cautery training, mannequin and OR table with skin pre/drapes for sterile technique)
11. Craniotomy and Neurosurgical Instruments 101	**Technical:** common neurosurgical instruments, turning a craniotomy and bone flap fixation (plating), burrholes (Hudson-Brace perforator), craniotomy positioning and pin-fixation (adult/pediatric), skull surface landmarks and common cranial flaps	- Expert demonstration (neurosurgical instruments, craniotomy landmarks and flaps on a cadaver); part-task training (burrholes, turning a bone flap on animal scapula), high-fidelity simulation (positioning and pin-fixation using a cadaver)
Group discussion sessions:		
12. Being an effective resident (CanMEDS collaborator and professional role)	**Cognitive:** prioritizing the resident's work day, being an effective team member and team roles, OR etiquette	- Large group discussion (during introduction to the course)

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Table 1. *Continued*

Group discussion sessions:		
Case[a]	**Skills taught**	**Educational methods**
13. Maintaining work-life balance (CanMEDS Professional and Manager Role)	◦ Balancing personal and professional responsibilities ◦ Managing sleep, physical and mental health ◦ Managing a neurosurgical practice/career	- Small group discussions (during group social event)

[a]Each station was set up with the necessary instructional materials, including: (1) a projector or computer screen and laptop for presentation of case details and imaging; (2) cadavers to facilitate expert demonstration (e.g. craniotomy flaps, patient positioning, etc.); (3) neurosurgical tools and simulation platforms for skills training (e.g. simulated lumbar torso and lumbar puncture/drain kits); (4) dedicated, high-fidelity simulation space and patient-simulators (e.g. high-fidelity mannequin with cranial trauma) for team, communication and emergency management skills training. CT = computed tomography, SAH = sub-arachnoid hemorrhage, CSF = cerebroplsinal fluid, VP = ventriculoperitoneal, EVD = external ventricular drain, EDH = epidural hematoma, XR = X-Ray

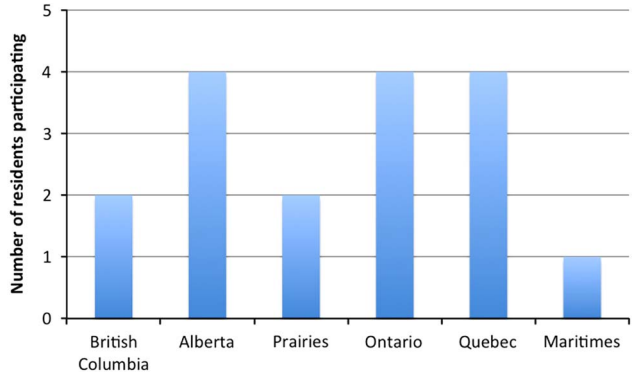

Figure 4: *Distribution of Rookie Camp Participants*

Post-hoc pairwise comparisons revealed that scores improved between the pre-test and immediate post-test (70% to 81%, $p < 0.002$ for 'taught' questions), whereas no significant change was observed from post-test to retention test. In addition, a trend of increasing difference in the percentage of correct responses before and after the course was observed between "taught" vs. "non-taught" questions. These results demonstrate that participants' knowledge improved significantly for content taught in the course, as compared with unrelated content, and that this knowledge was retained up to three months later. In addition, a narrowing of the confidence interval for questions concerning course material, but not for other questions, suggests that the course also narrowed the knowledge gap between participants.

Discussion

A number of recent publications describe standardized residency orientation programs for senior medical students[1,2,17] and 'bootcamp' courses[3,18-20] for junior residents in in obstetrics and gynecology,[21] cardiac surgery,[15] orthopedics,[14] and neurosurgery.[13,22,23] Results from these programs are encouraging, with evidence for improved self-confidence and perceived preparedness for clinical practice among participating trainees.[1,19] When augmented with simulation-based training, tangible improvements in clinical knowledge[13,23] and technical skills[14,20] have been observed. Emerging data also suggest these trainees demonstrate improved clinical performance when compared with matched peers within the first month of training, suggesting these educational experiences may also mitigate the "July effect" and improve patient safety.[3] The results from the inaugural Canadian Neurosurgery Rookie Camp add to this growing body of literature. To our knowledge, this Camp is the first national specialty-specific orientation program in Canada, and the second of its kind in the published literature.[13]

The perceived value of the Camp is evident in participants' course ratings, which suggest knowledge and skills taught at the Camp were value-added for PGY-1 residents. This is further supported by improved domain-specific knowledge test scores before and after the Camp and the retention of this knowledge after three months. These data suggest the Camp achieved one of its primary objectives: to standardize PGY-1 resident skills on entry into Canadian neurosurgical training. Participants also appreciated the opportunity to network with faculty and peers during the formal curriculum and at social events. This "socialization to the field" has been noted as an added benefit in other courses,[13] and may be beneficial in developing residents' sense of belonging to the Canadian neurosurgical community.

The station-specific comments provide insight into the value of specific teaching methods used during the Camp. For case-based stations, participants commented that incorporating multiple skills was particularly beneficial for learning. This suggests that residents value the opportunity to contextualize and integrate various cognitive, behavioural and technical skills required to manage a neurosurgical patient. Among the procedural skills stations, the highest ratings were awarded to basic skills training, which used simple, low-tech simulation to teach essential techniques such as asepsis, suturing, and bipolar cautery. Conversely, stations using 'high-tech' virtual reality simulation and part-task non-cadaveric simulation trainers were not rated as highly, despite their supposed increased fidelity for the clinical setting. This underscores a controversial aspect of simulation pedagogy: that higher fidelity (where fidelity is defined as a closer approximation of visual or surface features of the simulation to real clinical scenarios) does not necessarily translate into better learning.[24,25] Interestingly, this finding is in opposition to the results from other neurosurgical orientation courses.[13] It is clear that additional research is required in this area.

Regardless, simulation is increasingly being used in surgical education to facilitate both deliberate practice[26] of fundamental procedural skills and integration of cognitive, behavioural and technical aspects of surgical care delivery, in a setting free from concerns over patient safety.[27] There is now extensive evidence

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Table 2: Resident Rating[a] of Rookie Camp Stations

Case-based rating[b]					
Case	**Content consistent with objectives**	**Content was relevant for PGY-1 level**	**Sufficient time allotted for all activities**	**Teaching facilitated discussion/ questions**	**Sufficient time for interactive component**
1. SAH	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)
	Comments: Very clear and organized presentation, great information (3); Prolonged case with many components (1); Discussion about shunts was very useful (1)				
2. Posterior fossa tumour	4 (3-4)	4 (4-4)	4 (3-4)	4 (3-4)	4 (3-4)
	Comments: Practice/Review of the EVD was really useful, especially troubleshooting and discussion of shunts (6); Excellent station for hands on experience and it was very helpful to learn strategies for breaking bad news (4); The tumor caseand review of ICP management very useful (2); It would be helpful to watch a resident/staff demo [of EVD] (1)				
3. Trauma/ EDH	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)
	Comments: Well organized, practical, great teachers, good feedback. Should definitely be part of every residents learning (5); My favorite session of all - the simulation was very valuable, the trauma case was really realistic and the review of ICP management is very important (2); Some residents didn't get to do the telephone sim, but still took part in the feedback (1)				
4. Cauda equina	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)
	Comments: Good case, ample time for questions, good feedback as well (3); Discussion regarding ethics and consent was very beneficial. I have been asked to obtain consent previously not feeling totally comfortably doing so (3); Consider discussing a few common procedures/surgeries in terms of obtaining consent, eg. SAH, common spine (1); Reviewing red flags is a good idea (1)				
5. Spinal cord injury	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)
	Comments: Explanations for using the Halo device were really helpful, need to practice more (5); Extremely useful. Previous little exposure to this topic (1); Prefer to go through the process of mounting the halo on my own. Good to develop motor memory of the details. (1)				
6. Pituitary tumour	4 (3-4)	4 (3-4)	4 (3-4)	4 (4-4)	4 (3-4)
	Comments: Great interactive experience (7); Great hands-on practice (2); Nice introduction to endonasal approach (1)				
7. Status epilepticus	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)
	Comments: Excellent session, good review of things we should know (4)				
8. Lumbar CSF access	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)
	Comments: Great explanations and step by step tutoring (5); More time should be spent on lumbar drain (1); Good to practice LP set up (1)				
9. Hemostasis	4 (3-4)	3 (1-4)	4 (2-4)	4 (2-4)	4 (3-4)
	Comments: Interesting station, however I felt that it didn't teach as much as the other stations (2); Very quick, need more time/practice (2); Good station to practice hand coordination (1); Nice simulation, still needs some improvement (should be able to switch instruments) (1)				
10. Basic surgical skills	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)	4 (3-4)
	Comments: Great session: both the concept and the practical tips (3); Wish we had more time to practice (2); Good explanation of bipolar technique (2)				

Global Course Rating	
Statement	**% agreement**[b]
The ideas and practices taught at this rookie camp were new to me.	3 (2-4)
The idea and practices taught at this rookie camp are relevant to my role as a junior resident.	4 (3-4)
Information was conveyed in comprehensive manner.	4 (3-4)
I am likely to implement the ideas and practices taught in my work as a junior resident.	4 (4-4)
If I implement the ideas and practices taught at this rookie camp my patients are likely to benefit.	4 (3-4)
If I implement the ideas and practices taught at this rookie camp my teaching is likely to improve.	4 (3-4)
The location of the rookie camp was appropriate to the teaching and learning activities scheduled.	4 (4-4)
I would recommend this rookie camp to future neurosurgery residents.	4 (3-4)

[a]All items scored on a 4 point Likert scale, ranging from 1 = strongly disagree to 4 = strongly agree.
[b]Numeric scores represent median and range of responses to each question.

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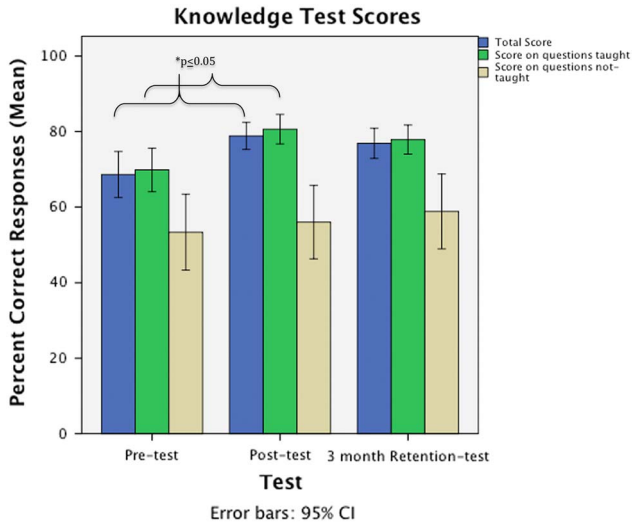

Figure 5: *Pre, Post and Retention Knowledge Test Results*

that simulation training has a large effect on improving knowledge, skills and clinical behaviour outcomes, while having a moderate effect on patient outcomes.[28] Within the surgical skills domain, multiple studies have demonstrated that skills learned in the simulated setting transfer to clinical practice.[29,30] However, the majority of these studies do not address neurosurgical skills, and thus further research in this area is warranted.

A number of limitations of the Rookie Camp experience should be acknowledged. First, the content and delivery of the Camp was evaluated using subjective ratings from participants, which may be influenced by the fact that respondents were first year residents who were being taught by senior residents and attending surgeons. Despite emphasizing the anonymous nature of responses, it is possible that participants held back from providing critical comments about the experience, so as not to offend the organizing committee. Second, as these trainees were just beginning their post-graduate training (most had not yet completed a neurosurgery rotation), their ratings are based on a limited knowledge of what neurosurgical residency entails, and should be interpreted with due caution. Third, the validity and reliability of the knowledge tests were not established beyond expert review of the questions. In addition, the same questions were used for each of the tests, introducing the potential for test-retest bias. Fourth, we are unable to comment on the impact of the Camp on practice behaviours of participating residents or subsequent patient outcomes; however, we hope to address this in part through post-course semi-structured interviews. Ongoing monitoring of complication rates for neurosurgical procedures performed by junior residents (e.g. EVD, lumbar puncture, etc.) may also be useful to demonstrate the impact of simulation training on neurosurgical outcomes.

We are similarly not able to comment on the impact of the Rookie Camp on the specific technical and behavioural skills taught, as these were not directly assessed. Although attempts were made by faculty to rate residents' performance during the various stations, this was found to be extremely difficult given that participants were in small groups and there was insufficient time to both complete the learning objectives and assess each participant in a rigorous manner. This is a major limitation in our evaluation, and in the evaluation of many post-graduate orientation programs.[2] In the future, efforts should be made to objectively assess changes in the skill-level of participating trainees (e.g. using objective structured assessment technical skills before and after the course).[20,31] However, to ensure the appropriateness of these assessments, measures of performance with appropriate validity evidence will need to be developed for the technical and behavioral skills in question.[32]

Finally, it is important to recognize that the Rookie Camp is a very intensive, but brief learning experience. As such, the educational benefits it affords to participants are necessarily limited, with the greatest impact likely to be affected in the first few months of residency training.[3] Given the ongoing pressures that hinder opportunities for resident education in the clinical setting and recent movements towards competency-based education,[33] the Camp should be viewed as an introductory experience to be coupled with longitudinal training opportunities for residents (both clinical and simulation-based) within their respective training programs.[13]

Based on the successes from this inaugural experience, the Canadian Neurosurgery Rookie Camp has been endorsed as an annual event. The organizing committee is committed to iterative course improvement: by incorporating resident feedback from the 2012 course, a number of improvements were made to the 2013 curriculum, including a revised course manual, reorganization of the hemostasis station and increasing time for fundamental skills training (e.g. EVD insertion). At the same time, the elements of the course that were rated highly (e.g. case-based teaching, small-group sizes, and opportunities for repeated, deliberate practice) were retained. Additional efforts to evaluate changes in residents' skills, practice behaviours and perhaps even patient outcomes will need to be incorporated in future courses to characterize the impact of the Camp across all outcomes of interest.

Conclusion

The inaugural Canadian Neurosurgery Rookie Camp was successfully delivered, with participation of PGY-1 trainees and faculty from across the country. Participants' evaluation of the course was positive and knowledge tests revealed the Camp promoted learning, retention, and a narrowing of knowledge gaps between participants on content taught during the course. Our experience has also highlighted areas for future research in neurosurgical education, including issues related to simulation fidelity and its impact on knowledge and skill acquisition, and the transfer of skills learned during courses like the Rookie Camp to clinical practice.

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Disclosures

None to disclose.

Supplementary Material

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