Perceived Barriers to the Development of Technical Skill Proficiency in Surgical Clerkship

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OBJECTIVE: Medical students are expected to achieve proficiency in a prescribed set of technical skills during surgical clerkship. However, available literature indicates students routinely report a lack of confidence and proficiency in these skills. Our study aims to identify barriers to technical skill development encountered by medical students during surgical clerkship with the goal of developing interventions to address these barriers.

DESIGN: Three hundred and forty two medical students were surveyed about their experience learning and performing technical skills during surgical clerkship. Students reported confidence in skill performance and subjective barriers to achieving competency using forced-choice and free-text responses. Multivariate regression models identified factors independently associated with specific barriers and more frequent technical skills performance.

SETTING: Main and satellite campuses of a Medical Council of Canada accredited Canadian academic medical center.

PARTICIPANTS: All third-year medical students.

RESULTS: A total of 253 students (74%) responded to the survey. Following surgical clerkship, the only technical skills participants felt confident performing independently were sterile technique (96%) and basic suturing (52%). Interest in a surgical career, observership experience, gender, and medical campus site were independently associated with the frequency of skill performance. With respect to developing technical proficiency, commonly cited barriers included lack of suitable cases for student participation (35.0%), time constraints (33.4%), and lack of opportunities provided by both consultants (29.1%) and residents (24.7%). Female gender was independently associated with decreased resident instruction, decreased confidence in skill performance, and fewer opportunities to perform requisite skills. Students at satellite campuses reported fewer barriers.

CONCLUSIONS: We identified (1) lack of suitable cases, (2) time constraints, and (3) failure to provide students opportunities as the most common barriers to technical skill proficiency. Female gender increased the perception of barriers, while there were fewer barriers perceived by students at satellite campuses. Skill-specific simulation training and other interventions may improve skill development in medical students given obstacles to developing proficiency in the clinical setting. (J Surg Ed 76:1267–1277. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: Undergraduate surgical education, barriers, technical skills, proficiency

COMPETENCIES: Patient Care, Practice-Based Learning and Improvement, Medical Knowledge

INTRODUCTION

Surgical clerkship provides the first exposure to procedural skills training for most medical students. During surgical clerkship, students engage in an apprenticeship model of education where they observe residents and

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surgeons performing skills and subsequently perform these skills under supervision. In 1998, the Association of American Medical Colleges published the Medical School Objectives Project (MSOP) to guide medical school clinical training curricula. The MSOP describes basic technical procedures in which all graduating medical students in the United States should be proficient: venipuncture, intravenous catheterization, arterial puncture, thoracentesis, lumbar puncture, nasogastric tube insertion, urinary catheter insertion, and suturing of lacerations.[1] In contrast, although the Medical Council of Canada has a set of objectives describing the expected knowledge base for medical graduates; there are no similar national objectives for technical skill training.[2]

Since the release of the MSOP, US medical students have self-reported a low level of proficiency in specific surgical skills.[3-7] Discrepancies between students' expected level of technical skill development going into clerkship and the actual level of technical expertise they achieve have been routinely described in the literature.[8] Addressing these discrepancies is important because (1) procedural proficiency is required in most postgraduate training programs, (2) the transition to competency-based education is becoming more prevalent, and (3) recent data highlights the role of a student's surgical educational experience in their decision to pursue a surgical career.[9-14] Specifically, active involvement in the operating room and other procedures during surgical clerkship has been linked to increased interest in a career in surgery.[9,12,13] In Canada however, the number of medical graduates applying to surgical specialties as their first choice residency discipline decreased from 21.7% in 2006 to 17% in 2016.[15,16] While the cause of this decrease is likely multifactorial, dedicated focus on technical skills teaching during surgical clerkship may increase the interest of medical students in surgical careers and help attract the best candidates to this field.

In an effort to improve technical skill proficiency in surgical clerkship, impediments to the development of these skills must be identified. While other studies have described possible barriers to skill development including time constraints, case complexity, and poor provision of opportunities,[10,12,14,17,18] no studies have quantified the impact of such specific barriers on the acquisition of technical skills during medical school. Our study aims to quantify the impact of specific barriers to procedural skill development in surgical clerkship.

METHODS

Study Setting

The 12 week surgical clerkship model at our institution consists of 4 weeks of general surgery, 2 weeks of anesthesiology, and 6 weeks in surgical subspecialties (2 weeks in each of 3 different disciplines). Procedural and technical requirements are published for students and educators, and students are required to log their technical experiences and achieve minimum procedural volumes in order meet passing requirements for surgical clerkship. Requisite skills are taught over one day of dedicated technical sessions at the beginning of the students' surgical rotation. Two additional simulation sessions were provided using a high-fidelity patient simulator, one in anesthesiology and one as part of the Trauma Evaluation and Management course.

Data Collection and Survey Design

We obtained approval to conduct this study from our Institutional Health Sciences Research Ethics Board (HSREB #109441). A survey using a combination of multiple-choice, 5-point Likert scales, and free-text question formats was designed by the authors. All questions and scales were created by our research team as the information we sought could not be collected through an existing validated questionnaire. The survey was piloted prior to administration using 15 students from the previous academic cohort. Feedback regarding survey item structure and content was considered and incorporated into the final survey where applicable.

A paper survey was offered to 342 third-year medical students at the Schulich School of Medicine and Dentistry at their mandatory exit evaluation session upon completion of a 12-week surgical clerkship. Electronic surveys were distributed to students who had excused absences from their exit evaluation session. Responses were collected between July 2017 and August 2018. We designed a 34-item survey that questioned students about their confidence and experience performing the 9 technical skills required at our institution: operating room (OR) sterile technique, wound closure (basic suturing), nasogastric (NG) tube placement, peripheral intravenous (IV) insertion, endotracheal intubation, alternative airway management (such as laryngeal mask airway placement), urinary catheter insertion, administration of local anesthesia, and casting. We requested information on the number of times a skill was performed prior to and during clerkship, as well as the level of supervision and the student's confidence during performance of these skills. Students were also asked to report perceived barriers to development of skill proficiency from a list of factors thought to impact technical learning. This list was developed from commonly cited themes in previous surgical education literature[10,12,14,17,18] and was limited to the following items: inappropriate case level for students (e.g., too complex, unstable patient), time constraints, inadequate provision

of opportunities for skill performance by (1) consultants, or (2) residents, discomfort with asking to participate, student failure to seek opportunities, student lack of confidence, an excess of student learners, and lack of instruction by either (1) consultants, or (2) residents. A free-text option was also available, enabling students to communicate perceived barriers that were not articulated among our response options. The survey also sought information about student interest in a surgical career before and after the completion of surgical clerkship.

Statistical Analysis

Descriptive statistics were used to define student demographics including gender, clerkship site (main or satellite campus), and time of surgical rotation (denoted by the months during which surgery clerkship was completed: blocks: 1 through 4). We reported student experience with technical skills, confidence in ability to perform skills, and perceived barriers to development of skill proficiency. Chi-square test was used for categorical variables. Multivariate logistic regression was used to identify independent predictors of more frequent opportunities for skill performance and the presence of perceived barriers to achieving competency in these skills. Multivariate analysis was completed for each technical skill and each candidate barrier. Covariates selected for the multivariate analysis were either significant in the bivariate analysis or identified as likely confounding variables. Statistical significance was set at an alpha of 0.05. All statistical tests were completed using SAS software (version 9.4, SAS Institute Inc., Cary, North Carolina).

RESULTS

The survey was distributed to 342 third year medical students. Two hundred and fifty three students completed the survey yielding a response rate of 74%. Study population demographics are described in Table 1. The majority of students (85.3%) completed their surgery clerkship rotation at academic hospitals associated with the main medical campus whereas 14.7% completed clerkship at a satellite campus hospital. Student technical experience before and after surgery clerkship is described in Table 2. The majority of students performed the following skills at least 5 times during their surgery clerkship: OR sterile technique (99.6%), peripheral IV insertion (91.3%), urinary catheter insertion (54.0%), suturing (84.9%), intubation (68.5%), and alternative airway management (71.7%). Three skills were less commonly performed: 21.1% never injected local anesthesia, 62.3% never placed an NG tube, and 68.6% never casted a patient (Table 2).

TABLE 1. Survey Participant Demographic Characteristics.

Characteristic	N	%
Gender		
Male	147	58.1
Female	101	39.9
Not specified	5	2.0
Clerkship site		
Victoria Hospital (main)	102	40.5
University Hospital (main)	108	42.8
Windsor Regional Hospital (satellite)	37	14.7
Other	5	2.0
Rotation timing		
Block 1	62	24.5
Block 2	60	23.7
Block 3	64	25.3
Block 4	67	26.5
More than one medical student on team (General Surgery)		
Never	37	14.6
Always	107	42.3
Yes, <50% of training time	31	12.3
Yes, >50% of training time	78	30.8
More than one medical student on team (subspecialty)		
Never	100	39.8
Always	7	2.8
Yes, <50% of training time	105	41.8
Yes, >50% of training time	39	15.6

Learner Confidence

Self-reported confidence in performing all nine technical skills is depicted in Figure 1. The majority of students felt confident performing only 2 of the 9 skills without direct supervision by the end of their surgical clerkship rotation: sterile technique (95.6%) and basic suturing (51.6%). They also reported poor confidence with NG tube placement and casting: 39.4% and 36.3% of students respectively had a lack of confidence performing these skills under any level of supervision (Fig. 1.).

Predictors of Skill Performance

Multivariate analysis of independent predictors for skill performance is shown in Table 3. Previous interest in a surgical career was an independent predictor for more frequent performance of urethral catheterization and basic suturing skills. Similarly, previous observership experience in a surgical specialty predicted more frequent performance of endotracheal intubation and injection of local anesthesia. Completing clerkship at a satellite campus and timing of rotation (block 3 rotation) were

TABLE 2. Self-reported Performance of Technical Skills Before and After Completion of the Surgical Clerkship, %.

Skill	1-4 times	5-10 times	>10 times	Never
Prior to surgical clerkship				
OR sterile technique	**40.7**	16.6	19.0	23.7
Peripheral IV insertion	33.3	0.8	4.8	**61.1**
Urethral catheterization	23.1	3.6	3.2	**70.1**
Basic suturing	**40.6**	20.3	12.0	27.1
Endotracheal intubation	13.5	0.8	2.4	**83.3**
Airway management	15.1	3.6	3.2	**78.1**
Injecting local anesthetic	35.6	10.8	7.2	**46.4**
NG insertion	11.1	0	0.4	**88.5**
Casting	**49.2**	1.6	1.6	47.6
Following surgical clerkship				
OR sterile technique	0.4	4.4	**95.2**	0.0
Peripheral IV insertion	6.7	22.2	**69.1**	2.0
Urethral catheterization	**41.6**	34.9	19.1	4.4
Basic suturing	14.3	37.7	**47.2**	0.8
Endotracheal intubation	29.5	**42.2**	26.3	2.0
Airway management	26.3	**40.2**	31.5	2.0
Injecting local anesthetic	**48.6**	15.9	14.4	21.1
NG insertion	34.9	2.4	0.4	**62.3**
Casting	27.0	3.6	0.8	**68.6**

Bold denotes as per our draft submission.

independent predictors of increased experience performing endotracheal intubation and administration of local anesthetic respectively (Table 3). Conversely, female gender was a negative predictor for performance of airway management skills. There were no independent predictors for increased frequency of performance for sterile technique, IV insertion, NG insertion, or casting.

Barriers to Skill Development

Of the 9 barriers assessed in the survey, assignment to operative cases not appropriate for student participation was the most commonly cited barrier overall for all technical skills, identified as an issue by 35% of learners (Fig. 2). This was followed closely by time constraints (33.4%) and failure of consultants or residents to provide opportunities for skill development (29.1% and 24.7%, respectively; (Fig. 2). For individual skills, case appropriateness was the most frequently cited barrier for endotracheal intubation, alternative airway management, NG tube insertion, and casting (Table 4). Time pressure was the most common barrier for peripheral IV insertion, urinary catheter insertion, and suturing. Lack of opportunities from consultants was the most common barrier for

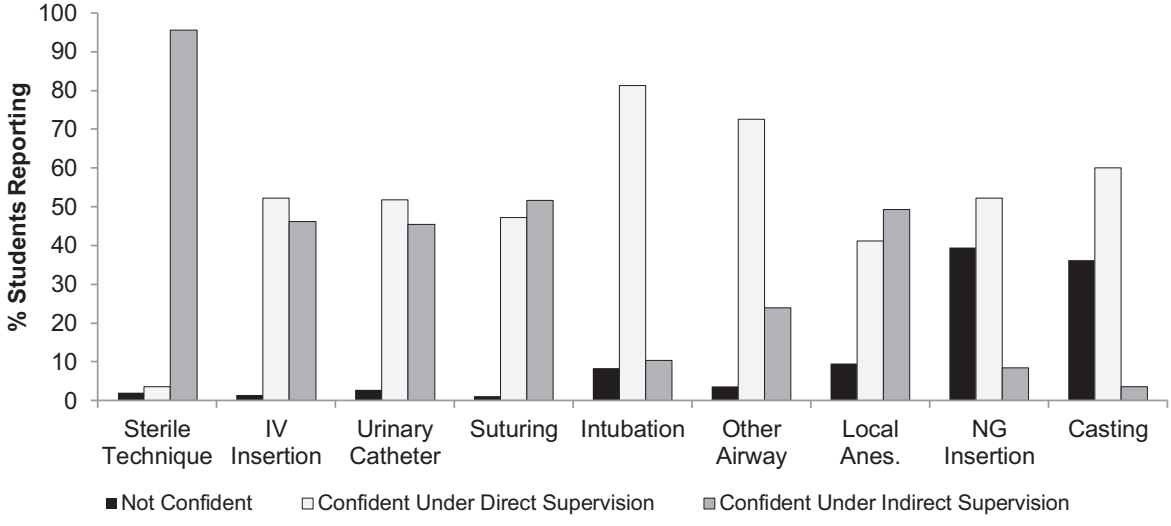

FIGURE 1. Self-reported confidence in performing each of the nine technical skills under direct supervision or indirect supervision.

TABLE 3. Multivariate Logistic Regression of Factors Affecting Frequency of Technical Skill Performance for Individual Technical Skills.

Technical Skill*	OR [95% CI]	p Value
OR sterile technique		
None significant	–	–
Peripheral IV insertion		
None significant	–	–
Urethral catheterization		
Previous interest in surgical career	3.16 [1.54-6.50]	0.002
Basic suturing		
Previous interest in surgical career	4.82 [1.29-18.00]	0.019
Endotracheal intubation		
Satellite campus	5.42 [1.54-19.06]	0.009
Previous observership experience	2.22 [1.17-4.24]	0.015
Other airway management		
Female	0.42 [0.23-0.77]	0.005
Local anesthetic		
Block 3 rotation	2.52 [1.09-5.82]	0.030
Previous observership experience	2.17 [1.14-4.14]	0.018
NG insertion		
None significant	–	–
Casting		
None significant	–	–

*Only statistically significant covariates are reported for each skill. Complete results of regression analysis are reported in Supplementary Table.

injection local anesthetic, and too many learners was the most common barrier for OR sterile technique (Table 4).

Independent Predictors for Encountering Barriers to Skill Development

Late surgical clerkship timing (block 4 rotation) was associated with poorer resident instruction. The only other covariate independently associated with greater perception of barriers to skill development was female gender, which was a predictor for inadequate resident instruction, poor provision of opportunities by residents, and poorer confidence (Table 5). Previous procedural observership experience was predictive of lesser difficulty with consultant instruction and, unsurprisingly, lack of interest in a surgical career was independently associated with student failure to seek opportunities. Clerkship at a satellite campus was independently predictive of less frequent identification of all barriers except for student failure to seek opportunities and lack of student confidence (Table 5). There were no independent predictors for perception of time constraints as a barrier to learning. Full multivariate regression results are reported in the supplementary materials (**Supplementary** Table 1).

Student Clerkship Experience

Student interest in a surgical career was 28.0% prior to surgical clerkship and 25.2% after surgical clerkship (χ^2 0.766, $p = 0.381$; (Fig. 3). 52.4% of students had

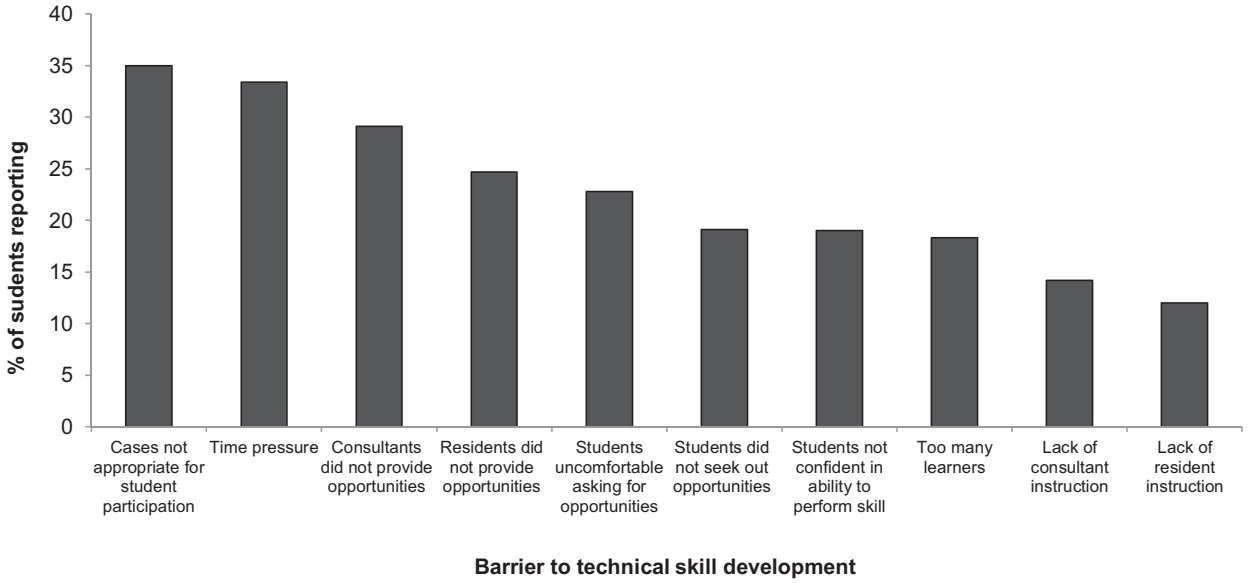

FIGURE 2. Perceived barriers to the development of technical skill proficiency for any technical skill (% students reporting barrier).

TABLE 4. Most Commonly Reported Barriers to Development of Individual Skills; Expressed as Percentage of Students Who Responded "Agree" or "Strongly Agree" to a Given Barrier Limiting Their Ability to Achieve Proficiency. For Each Skill, the Most Commonly-Reported Barrier to Development is **Underlined**.

Barrier	Sterile Technique	PIV insertion	Urethral Catheter	Suturing	ET Intubation	Airway	Local Anesthetic	NG Insertion	Casting
Cases not appropriate for student participation	15.7	40.9	29.4	36.8	**37.3**	**16.9**	38.9	**53.8**	**45.6**
Time pressure	13.7	**41.6**	**39.8**	**59.1**	33.7	16.5	36.4	34.6	25.1
Consultants did not provide opportunities	9.2	31.6	24.1	41.7	18.0	6.2	**49.6**	49.3	32.5
Residents did not provide opportunities	6.4	26.0	24.5	37.3	6.6	3.7	42.6	46.5	28.8
Students uncomfortable asking for opportunities	13.3	29.0	20.0	32.5	15.2	5.0	32.6	35.1	22.8
Students did not seek out opportunities	6.4	22.7	18.8	15.4	7.0	4.1	29.8	41.3	25.7
Students not confident in ability to perform skill	4.8	17.6	17.6	17.8	26.2	9.5	14.5	36.5	27.4
Too many learners	**23.9**	8.5	19.2	44.5	5.7	2.5	19.8	19.6	12.1
Lack of consultant instruction	10.0	8.1	16.4	18.6	5.7	2.1	21.9	28.5	16.7
Lack of resident instruction	8.0	8.1	10.6	11.8	2.1	2.1	19.4	29.3	16.3

Bold denotes as per our draft

procedural observership experience prior to surgical clerkship. When surveyed on subjective experience, 92.4% of students enjoyed performing technical skills, 85.6% took advantage of all opportunities presented to perform skills, and 69.2% sought further opportunities to perform skills. Only 5.2% of students actively avoided opportunities to perform skills. 75.1% of students practiced skills on their own time. Finally, 82.9% of students

TABLE 5. Logistic Regression Analysis of Factors Affecting Barrier Identification.

Barrier*	OR [95% CI]	p Value
Cases not appropriate for student participation		
Satellite campus	0.31 [0.12-0.79]	0.014
Time pressure	–	–
None significant		
Consultants did not provide opportunities		
Satellite campus	0.34 [0.14-0.84]	0.020
Residents did not provide opportunities		
Female	3.12 [1.40-6.94]	0.005
Satellite campus	0.02 [0.007-0.07]	<0.001
Students did not feel comfortable asking for opportunities		
Satellite campus	0.41 [0.19-0.91]	0.029
Unsure of previous interest in surgical career	0.38 [0.15-0.91]	0.031
Students did not seek out opportunities		
Previous interest in surgical career	0.39 [0.20-0.78]	0.007
Students not confident in ability to perform skills		
Female	2.03 [1.11-3.72]	0.022
Too many learners		
Satellite campus	0.03 [0.01-0.10]	<0.001
Lack of consultant instruction		
Satellite campus	0.46 [0.21-0.99]	0.046
Previous observership experience	0.54 [0.30-0.96]	0.036
Lack of resident instruction		
Female	1.94 [1.05-3.59]	0.036
Satellite campus	0.02 [0.002-0.14]	<0.001
Block 4 rotation timing	3.64 [1.50-8.90]	0.005
Previous observership experience	0.50 [0.27-0.95]	0.033

*Only statistically significant covariates are reported for each barrier. Complete results of regression analysis are reported in Supplementary Table.

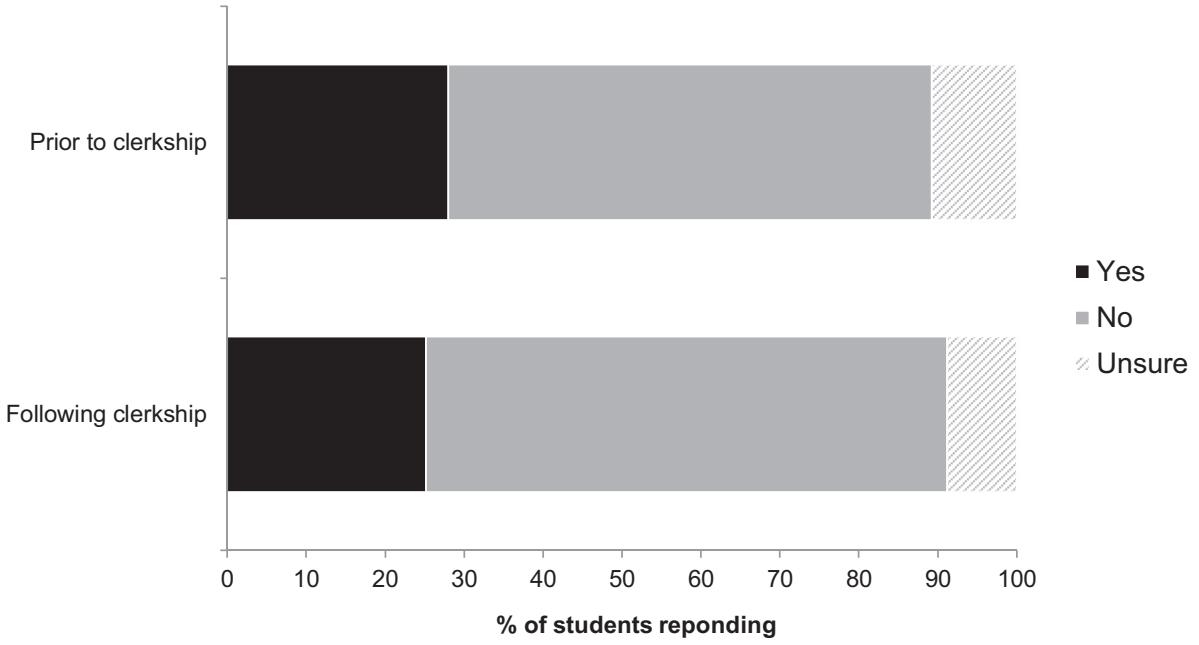

FIGURE 3. Student-reported interest in a surgical career prior to and following surgical clerkship and previous surgical observership experience.

indicated that surgical clerkship was an overall positive experience (Supplementary Table 2).

DISCUSSION

Our study examined the medical student experience in learning and performing technical skills throughout surgical clerkship. While student experience and confidence performing technical skills has been previously studied,[3-7] this is the first study to identify barriers to developing skill proficiency in surgical clerkship. Unique to this study was the identification of a set of skill-specific barriers limiting medical students' achievement of technical skill proficiency.

At our institution, the majority of students performed most technical skills at least 5 times throughout their surgical clerkship, which exceeds the level of experience reported in previous studies in the United States.[3-7] In contrast, Dehmer et al., reported a survey of graduating medical students which found that, of the 8 MSOP skills, only suturing and urinary catheter insertion were performed more than twice by 50% of students.[4] Similarly, Wu et al., reported that many third-year medical students had performed basic skills including intravenous catheterization (47%), nasogastric tube placement (61%), urinary catheter insertion (22%-32%), and basic suturing (29%) only one time or not at all.[6].

In general, students in our study felt confident performing the prescribed technical skills under supervision reasonable for their level of training: 96.4% of students were confident performing OR sterile technique under indirect supervision, while 84.3% and 73.4% of students felt confident performing endotracheal intubation and alternative airway management, respectively under direct supervision. Experience and confidence performing NG tube placement and casting was low compared to other skills and more consistent with values reported in other studies.[3,5,6]

The primary focus of this study was barriers to technical skill development. For NG tube placement and casting, 51.9% and 37.2% of students respectively reported that their inability to achieve proficiency arose from the cases being inappropriate for student participation (due to acuity, risk of further harm, or other patient factors). Students' low level of experience and confidence performing NG tube insertion and casting suggest a need for additional learning tools to increase exposure to and training in these skills, especially given our finding that the complexity of patients for which these procedures are necessary provides a barrier to learning in itself. As case complexity may not be a modifiable barrier, other solutions are necessary. Simulation is a potential avenue to increase technical skill exposure and has been shown to be an effective tool for skills training.[19-21] A 2007 study by Stewart et al. showed that a 30-minute preclerkship skills session increased students' proficiency and confidence in performing NG tube placement and decreased students' anxiety about the procedure.[22] For students who are unable to get adequate instruction and practice on inpatient wards, dedicated skills sessions could be useful to increase exposure and confidence. At

our institution, students had the opportunity to practice casting skills on peers during a dedicated preclerkship boot camp skills session, which they reported to be a very helpful learning tool. Dedicated sessions where students practice casting and NG tube insertion on peers may address the lack of opportunities to perform these skills in real-life clinical scenarios.

When used correctly, dedicated skills sessions are excellent learning tools for improving procedural competency and eliminate barriers such as resident or consultant failure to provide opportunities, and time constraints. In 2013, Herrmann-Werner et al. developed the "Best Practice Skills Lab" (BPSL) training technique which included structured feedback, practice on mannequins, and Peyton's 4 step approach to NG insertion and IV cannulation[23]: (1) initial teacher demonstration, (2) repeat demonstration with description of all necessary substeps, (3) student explanation of each substep with the teacher following the student's instructions, and (4) independent performance of the skill by the student. Compared to a traditional "see one, do one" methodology of most skills sessions, BPSL training resulted in improved immediate recall and performance as well as increased long-term retention at 3 and 6 months.[23] Students also received higher competency marks on rotation assessments. Although it would be challenging to implement a BPSL approach for all 9 techniques examined in this study, it is an approach to consider for procedures performed less frequently by medical students, or for those of higher complexity.

Student characteristics are nonmodifiable factors that should also be considered when identifying barriers to technical skill development. Because there are no residents, students at satellite campuses reported fewer perceived barriers to their technical skill development during the clerkship year. On regression analysis, students completing undergradaute surgical training at a satellite campus were not uncomfortable seeking opportunities, were less commonly excluded from cases because of complexity, did not feel an excess of learners impeded their training, and did not perceive a lack of instruction or opportunities during their training. Ultimately however, the only skill that students at satellite campuses performed more frequently was endotracheal intubation. This finding may serve as a call to residents to ensure they are conscientious about providing opportunities for medical students wherever possible, and also may suggest that simulation interventions to improve technical skill proficiency are especially important in academic medical centers that train residents.

Gender bias has been studied in medical education and is a subject of interest that has been gaining traction in surgical disciplines.[24-27] Despite equal or superior performance to their male counterparts, female medical students routinely report lower levels of self-confidence and higher anxiety with respect to their clinical skills,[24,25] which may further perpetuate implicit biases held by female trainees regarding their own performance. In our study, female students reported less resident instruction, fewer opportunities provided by residents to perform requisite skills, and poorer confidence in technical ability. Since female gender did not actually predict for less frequent performance of most technical skills, this finding suggests that the climate of surgical education is such that female students—although reaching the same number of procedures as their male counterparts—may not be receiving equal instruction and may have to work harder for these opportunities. There was no difference in gender with respect to seeking opportunities, and thus our findings do not stem from female students failing to ask for instruction or from lack of interest. This disparity requires further exploration in order to devise system changes to overcome it, and is an active subject of study for our research group.

Students with a previous interest in surgery and those who completed procedural observerships prior to clerkship were more likely to perform urethral catheterization, basic suturing, endotracheal intubation, and injection of local anesthesia. Furthermore, these same students were less likely to identify inadequate instruction from consultants and residents as barriers to their learning. It is possible that the targeting of dedicated technical skills session and the promotion of observership opportunities to preclerkship students may also be an effective way to develop technical skill experience in medical students and reduce perceived barriers to skill acquisition. In a study by Moore et al. in 2014, students engaged in a resident preceptor model of education reported feeling more comfortable asking questions in a clinical setting and felt that their teaching by residents improved.[17] Moore et al. evaluated the resident preceptor teaching model in the general context of surgical education, but could be specifically applied to technical skills training during surgical clerkship as well as for preclerkship students. A year-long monthly resident shadowing program for first-year medical students has been successfully established at one Canadian institution with anecdotally positive results. Such programs have the potential to increase early technical skills exposure for medical students and reduce educational barriers.

Environmental barriers to skill development such as too many learners, inadequate instruction, and consultants or residents not providing opportunities are also of substantial concern to medical students and institutions trying to optimize their educational models. In our study, students completing clerkship at the satellite campus had increased technical skill performance and were

less likely to identify environmental factors as barriers to their learning. At this satellite site, there are fewer residents, and students spend more time in direct contact with consultant surgeons. It has been previously shown that direct contact and teaching by consultants correlates with increased operating room participation and overall student learning satisfaction.[28,29] At a busy academic center, direct contact with consultants is often limited for medical students. The previously mentioned resident preceptor model may be an option to increase direct, one-on-one teaching time for students. An additional option to supplement direct instruction in technical skills training is peer-assisted learning. This option does not require faculty or residents to be available for sessions and has been shown to be effective in increasing student confidence in basic suturing skills.[30]

Senior medical students have frequently indicated a desire for greater technical skill competency[4,8] and more active involvement in the operating room and procedures.[8-11] The majority of students enjoyed performing technical skills, taking all opportunities presented to them, and seeking out additional practice opportunities. Furthermore, three quarters of students used nonclinical time to practice skills independently. With the identification of skill-specific barriers to proficiency, we can begin to consider targeted interventions to improve technical skill development, increase student confidence after clerkship training, and potentially attract more candidates toward surgical careers.

Limitations

Our study was subject to a number of limitations. Our survey design encouraged response conformation to our forced-choice options; while we also provided a free-text alternative for perceptions that did not conform to our provided response options, this approach may have resulted in some nuanced perceptions being missed. As with any retrospective study—and notably with surveys—recall bias is a concern. We attempted to minimize recall bias by administering the survey at the final evaluation session immediately following the completion of the students'12-week surgical rotation.

Other biases related to student perceptions may have entered the study based on the timing of their rotation during the academic year and the site at which their surgical clerkship was completed. We aimed to statistically minimize these biases by using a multivariate regression model that controlled for these variables when identifying independent predictors of procedure performance or perceived barriers.

Finally, results were collected from a single institution based on institution-specific learning objectives. Currently in Canada, there is no unifying set of objectives for technical skills teaching in medical schools. Therefore, the skills investigated and results obtained in this study may not be generalizable to other Canadian centers or institutions outside of Canada. A national set of objectives for technical skills training would not only standardize teaching but would allow for further study of barriers to skills development across centers. It is likely that standardized objectives will be developed as competency-based medical education is adopted over the upcoming years.

CONCLUSIONS

This study examined technical skill development in surgical clerkship as well as barriers perceived to limit the achievement of skill proficiency. The most common barriers were assignment to cases that were unsuitable for student participation, time constraints, and lack of opportunities provided by consultants and residents. For resident or consultant instructors, these perceptions must be acknowledged and addressed to ensure adequate technical training for medical students. Our results suggest procedural training at the start of clerkship is insufficient to ensure adequate procedural volume and the subsequent development of student confidence and proficiency. Students with a previous interest in surgery or previous observership experience were more likely to perform common skills such as basic suturing and urethral catheterization and less likely to encounter barriers, which also implicate students' attitudes and motivation in making opportunities for themselves to perform procedures. Additionally, students at the satellite campus were overall more likely to perform procedures and less likely to identify environmental barriers to their learning, suggesting that an increased student to instructor ratio at busy academic centers may dilute the number of opportunities per student to perform procedures. Dedicated skills sessions utilizing the BSPL model and resident preceptor learning models may be effective supplements to students' clinical learning to improve technical experience and confidence. Future research aimed at expanding data collection across Canadian centers will aid in the development and implementation of national technical skills objectives and training curricula for undergraduate medical students. Further study examining gender disparities in surgical training is warranted.

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SUPPLEMENTARY INFORMATION

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