OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE

Education

Results of a Pilot Virtual Microsurgery Course for Plastic Surgeons in LMICs

Greta L. Davis, MD*
Metasebia W. Abebe, MD, FC (ECSA), MPH†
Raj M. Vyas, MD‡
Christine H. Rohde, MD, MPH§
Michelle R. Coriddi, MD¶
Andrea L. Pusic, MD||
Amanda A. Gosman, MD**

Background: The Plastic Surgery Foundation's Surgeons in Humanitarian Alliance for Reconstruction, Research and Education (SHARE) program seeks to expand surgical capacity worldwide through mentorship and training for local plastic surgeons. This study aims to define the need for microsurgery training among SHARE global fellows and describe results of a pilot course.

Methods: Ten participants of the SHARE Virtual Microsurgical Skills Course were asked to complete an anonymous survey. Pre- and post-course response rates were 100% and 50.0%, respectively.

Results: There was a high incidence of microsurgical problems encountered in the clinical setting. Resource availability was varied, with high access to loupes (100%), yet limited access to microsurgery instruments (50%), medications (40%), operating microscope (20%), skilled nursing (0%) and appropriate perioperative care settings (0%). Participants identified vessel preparation, instrument selection, and suture handling as priority learning objectives for a microsurgery skills course. Post-course satisfaction with learning objectives was high (60% "very good," 40% "excellent"). Participants reported high levels of improvement in suture handling (Likert 4.60±0.55), end-to-end anastomosis (4.40±0.55), instrument selection (4.20±0.45), vessel preparation (4.20±0.45), and economy of motion (4.20±0.45).

Conclusions: This study demonstrates a high frequency of reconstructive problems encountered by global fellows yet low access to appropriate resources to perform microsurgical procedures. Initial results from a pilot virtual microsurgery course demonstrate very high satisfaction and high self-rated improvement in key microsurgical skills. The virtual course is an effective and accessible format for training surgeons in basic microsurgery skills and can be augmented by providing longitudinal opportunities for remote feedback. *(Plast Reconstr Surg Glob Open 2024; 12:e5582; doi: 10.1097/GOX.0000000000005582; Published online 12 February 2024.)*

*From *Division of Plastic and Reconstructive Surgery, Department of Surgery, University of California, San Francisco, San Francisco, Calif.; †Plastic and Reconstructive Surgery, Saint Paul Hospital Millennium Medical College, Addis Ababa, Ethiopia; ‡Department of Plastic Surgery, University of California, Irvine, Orange, Calif.; §Division of Plastic and Reconstructive Surgery, Department of Surgery, Columbia University Medical Center, New York, N.Y.; ¶Plastic and Reconstructive Surgery Service, Department of Surgery, Memorial Sloan Kettering Cancer Center, New York, N.Y.; ||Division of Plastic and Reconstructive Surgery, Department of Surgery, Brigham Health, Boston, Mass.; and **Division of Plastic Surgery, Department of Surgery, University of California, San Diego, San Diego, Calif.*

Received for publication August 21, 2023; accepted December 19, 2023.

DOI: 10.1097/GOX.0000000000005582

INTRODUCTION

Microsurgical techniques are an essential component of the modern plastic surgeon's toolkit. However, microsurgery is largely unavailable in many developing countries, particularly in sub-Saharan Africa. Among a number of challenges faced by plastic surgeons in this region are a reported shortage of surgical expertise and lack of adequate, local microsurgery training.[1]

Given the wide geographical spread of plastic surgeons in low- and middle-income countries (LMICs), high costs related to travel, and time constraints from visiting and in-country surgeons, there is increasing need for remote training opportunities to supplement local initiatives. Further, with a ratio of fewer than 0.14 plastic surgeons to one million people in sub-Saharan Africa,[2] there is

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

tremendous pressure on existing surgeons to manage complex and diverse reconstructive challenges in their daily practice. Therefore, the development of an effective and reproducible virtual skills course is an important early step in expanding microsurgery capacity in these regions.

To address these issues, The PSF-sponsored Surgeons in Humanitarian Alliance for Reconstruction, Research and Education (SHARE) program was developed to enhance collaboration and improve surgical capacity in regions with few plastic surgeons but high burden of conditions requiring plastic surgery treatment. In 2021, the program launched a pilot virtual microsurgery course as an early step to improve the microsurgery experience for partner surgeons in sub-Saharan Africa. This study aimed to quantify the need for accessible basic microsurgery skills training for plastic surgeons in LMICs and to describe results of a pilot virtual microsurgery course to better inform future iterations.

Takeaways

Question: To define the need for basic microsurgery skills training and describe results of a pilot, virtual microsurgery skills course for surgeons in low- and middle-income countries

Findings: Participants identified priority learning objectives which were used to guide microsurgery course design. After completion of the course, there was improvement in self-reported confidence with essential microsurgery skills, including suture handling, instrument selection, vessel preparation, economy of motion, and end-to-end anastomosis.

Meaning: A virtual format for microsurgery skills training is an accessible and effective model for introducing basic microsurgery skills to surgeons in resource-constrained settings.

METHODS

Ten surgeons at various levels of training participated in a 1-day virtual microsurgery skills course hosted by the SHARE program. Participants were self-selected from the 2021–2022 SHARE global fellowship cohort and included plastic surgery residents and junior surgeons in LMICs with limited exposure to microsurgery.

Course Design

The virtual course was designed according to participant-identified learning objectives and the previously published International Microsurgery Simulation Society Consensus on minimum standards for a basic microsurgery course.[3] Given the virtual nature of the course and collaboration across multiple time zones, some modifications from these standards were required, including use of loupe magnification in place of an operating microscope and consolidating skills sessions to a 4-hour live course supplemented by self-directed practice over a period of weeks. The virtual skills course curriculum is outlined in Table 1.

Before the course, participants were provided with low-cost microsurgery instrument kits purchased from an online retailer (US $15.99), which included two forceps, a curved needle holder, micro scissors, and a vessel dilator; microsuture ranging from size 8-0 to 10-0 (US $3.33/ pc); instructions for a previously published low-cost box trainer setup utilizing readily available cardboard, tape, camera phone and light source;[4] and instructional lectures detailing techniques reviewed during the workshop. Microsurgery instrument kits and shipping costs were donated through SHARE,

Table 1. SHARE Virtual Microsurgery Skills Course Curriculum

Topic and Learning Objectives	Format	Time Allocated
Introduction to microsurgery • Understand concept of microsurgery • Describe role of microsurgical techniques in everyday practice • Introduce course progression from macro to microsurgical models	Lecture	15 min
Use of microsurgical instruments (with faculty demonstration) • Identify name and purpose of each microsurgical instrument • Demonstrate basic posture, handling, and care of instruments • Understand needle/suture properties and choice of suture	Lecture	30 min
Basics of suturing (with faculty demonstration) • Explain features of ideal suture placement • Demonstrate appropriate needle handling, insertion, and pull-through • Demonstrate appropriate knot tying technique	Lecture	30 min
Pre-test: optional practical using chicken thigh model/ latex glove		15 min
Simple suture exercises on latex glove “macro” model (with 1:1 faculty feedback) • Demonstrate proper posture and hand/wrist positioning • Demonstrate appropriate instrument selection and use • Demonstrate appropriate needle handling, insertion, pull-through, and tie-off in a micro model	Breakout session	1 hour
Vessel dissection and end-to-end anastomosis on chicken thigh “micro” model (with 1:1 faculty feedback) • Demonstrate appropriate tissue handling and instrument selection for dissection, vessel preparation, and anastomosis • Demonstrate appropriate needle handling, insertion, pull-through, and tie-off in a micro model	Breakout session	1 hour
Post-test: optional practical using chicken thigh model/ latex glove		15 min
Concluding remarks	Lecture, Q&A session	15 min
Total time allocated		4 hours

which is sponsored by The Plastic Surgery Foundation. All participants used loupes for magnification.

The virtual microsurgery course was hosted using Zoom videoconferencing software (Zoom Video Communications Inc., San Jose, Calif.). Smart phones with video capability were mounted on assembled box trainers to enable remote observation of participants' operative fields. For breakout sessions, participants were assigned to virtual workrooms consisting of two instructors and two learners for an instructor-to-participant ratio of 1:1. Instructors included board certified plastic surgeons with specialty training in microsurgery and at least 5 years of experience as educators.

Content experts provided lectures on the clinical application of microsurgery, use of microsurgical instruments, and basics of suturing. Breakout sessions included simple suturing techniques using a latex glove macro model and more advanced microsurgical techniques using a chicken thigh model, as described by Jeong et al.[5] After a demonstration, participants were asked to complete simple suturing in the latex glove model and an end-to-end arterial anastomosis using chicken femoral vessels. Throughout the course, participants were supervised closely by course faculty and received formative feedback during performance of various basic microsurgery skills. [**See Video (online),** which shows sample virtual breakout session illustrating faculty demonstration and 1:1 feedback using chicken thigh model for microvascular anastomosis.]

Course Evaluation

Participants were asked to complete anonymous pre- and postcourse surveys. The precourse survey included a microsurgery needs assessment and questions about level of training, prior microsurgery experience, and participant-identified learning objectives to guide course design. The postcourse survey evaluated participant satisfaction and subjective confidence scores with various microsurgery skills.

Statistical analysis was performed using IBM SPSS version 26 (IBM Corp., Armonk, N.Y.). Descriptive statistics were used, and performance data were analyzed using *t* tests where possible. Data were considered statistically significant if $P = 0.05$ or less.

RESULTS

A total of 10 SHARE global fellows from five countries in Sub-Saharan Africa participated in the course. The precourse survey response rate was 100%. Most participants were junior-level plastic surgery attendings (50.0%), whereas the remainder were residents or fellows in year 6+ (30.0%), year 5 (10.0%), or year 4 (10.0%).

Microsurgery Needs Assessment

The incidence of microsurgical problems encountered in the year before survey completion was high, with 70% of respondents reporting more than 15 of such patient encounters (Table 2). The most common microsurgical problems encountered were upper extremity and hand (80%), lower extremity (70%), and head and neck (70%).

Table 2. Results of a Microsurgery Needs Assessment Questionnaire

	n (%)
Prior microsurgical training	
None	0 (0%)
Operating room (under microscope)	4 (40%)
Operating room (observation)	6 (60%)
Live animal laboratory	5 (50%)
In-person suture laboratory/workshop	7 (70%)
Virtual suture laboratory/workshop	5 (50%)
Microsurgical anastomoses performed in past year	
0	2 (20%)
1–10 times	8 (80%)
10+ times	0 (0%)
Frequency of microsurgery problems encountered in past year	
0	0 (0%)
1–5 times	2 (20%)
6–10 times	1 (10%)
11–15 times	0 (0%)
More than 15 times	7 (70%)
Types of microsurgical problems encountered in past year	
None	0 (0%)
Perineum	3 (30%)
Trunk/abdomen	3 (30%)
Breast	3 (30%)
Head and neck	7 (70%)
Lower extremity	7 (70%)
Upper extremity/hand	8 (80%)
Access to microsurgical resources at institution	
Loupes	10 (100%)
Operating microscope	2 (20%)
Microsurgical instruments	5 (50%)
Microsurgical medications	4 (40%)
Postoperative monitoring	0 (0%)
Postoperative care setting	0 (0%)
Postoperative skilled nursing	0 (0%)

Regarding access to microsurgery resources, 100% of participants had access to loupes whereas only 20% had access to an operating microscope. Fifty percent had access to microsurgical instruments and 40% reported access to appropriate medications, yet 0% had access to resources for postoperative monitoring, skilled nursing, or appropriate inpatient care settings.

All respondents had some form of prior microsurgical training, including in-person skills lab (70%), virtual skills laboratory (50%), live animal laboratory (50%), operating room observation (60%), and direct operative experience under the microscope (40%). Eighty percent of participants had intermediate microsurgery experience (1–10 anastomoses in past year), whereas 20% were novice microsurgeons (0 anastomoses in past year; Table 2). Participants ranked vessel preparation, instrument selection, and suture handling as the most important learning objectives for a microsurgery skills course (Table 3).

Participants were asked to identify their precourse confidence level with various microsurgery skills on a Likert scale, with a score of 1 corresponding to "not at all confident" and 5 corresponding to "extremely confident."

Table 3. Participant-identified Learning Objectives for Virtual Microsurgery Course

Ranked Importance of Each Skill as Focus of Course*	Mean (SD)
Vessel preparation	3.40 (2.63)
Instrument selection	3.70 (2.50)
Suture handling	3.90 (2.47)
Chicken thigh model	5.20 (4.21)
End-to-end anastomosis	5.30 (1.64)
End-to-side anastomosis	5.80 (1.81)
Economy of motion	6.10 (2.73)
Venous anastomosis	7.40 (3.03)
Testing flow/ patency	7.70 (1.83)
Postoperative monitoring/ care	8.60 (2.32)

*Ranked 1–10.

Participants were confident to very confident in theoretical microsurgery skills including indications for microsurgery (mean Likert score 3.50 ± 0.97), appropriate flap selection (3.20 ± 1.03), perioperative care and monitoring (3.00 ± 1.15), and role of microsurgical medications (2.90 ± 0.99). Participants reported lower confidence with technical microsurgery skills including ability to perform flap harvest (2.60 ± 1.07), ability to perform microsurgical anastomosis (2.10 ± 1.10), and ability to manage complications of microsurgery (1.80 ± 0.92; Fig. 1).

Results from the Pilot Course

The postcourse survey response rate was 50.0%. After course completion, participants reported high satisfaction with course learning objectives (mean Likert score 4.40 ± 0.55), utility of breakout sessions (4.40 ± 0.55), quality of instructor feedback (4.40 ± 0.55), quality of instructor presentations (4.20 ± 0.45), and applicability to practice (4.20 ± 0.84); and moderate satisfaction with course setup and equipment (4.00 ± 0.71), time allocated to breakout sessions (4.00 ± 0.71), time allocated to lectures (3.80 ± 0.84), and telementoring format (3.80 ± 0.84; Fig. 2).

There was a trend toward improvement when comparing pre- and postcourse confidence levels with various microsurgical skills, yet the study was underpowered to detect significance (Table 4). Likert analysis revealed a high level of self-reported improvement in suture handling (4.60 ± 0.55), use of the chicken thigh model (4.60 ± 0.55), end-to-end anastomosis (4.40 ± 0.55), instrument selection (4.20 ± 0.45), vessel preparation (4.20 ± 0.45), and economy of motion (4.20 ± 0.45; Fig. 3). We were unable to objectively measure pre- and postcourse performance due to time constraints and limited response rate for submission of videos and/or photographs for evaluation.

Participants were asked about preferences for longitudinal skills assessment as a component of the microsurgery curriculum, and 100% expressed interest in this mode of feedback. Sixty percent of participants preferred video-based and 40% preferred photograph-based formats for skills assessments, with 100% of participants agreeing on a monthly assessment frequency.

DISCUSSION

An effective microsurgery skills course for surgeons in LMICs must be adaptable to the needs of both the in-country learner and visiting educator. Below we detail our recommendations based on experience and feedback following completion of a pilot virtual microsurgery workshop.

Benefits and Challenges of Virtual Surgical Skills Training

The era of COVID-19 amplified existing challenges in global surgical education, namely high costs of travel, wide geographic distribution of trainees, and the impracticality of traditional, resource-intensive training models. Distance mentorship is widely used in surgical training to circumvent these constraints. Studies have shown that telementored surgeons perform better on objective skills assessments, incorporate new skills into practice, and have fewer complications post mentoring.[6] This virtual microsurgery curriculum seeks to make surgical training accessible through a low-cost, reproducible, and technology-driven design.

	Mean (SD)	Not at all confident	Somewhat confident	Confident	Very confident	Extremely confident
Indications for microsurgery	3.50 (0.97)	0.0%	20.0%	20.0%	50.0%	10.0%
Appropriate flap selection for microsurgical reconstruction	3.20 (1.03)	10.0%	10.0%	30.0%	50.0%	0.0%
Microsurgical medications and their role	2.90 (0.99)	10.0%	20.0%	40.0%	30.0%	0.0%
Peri-operative monitoring and postoperative patient care setting	3.00 (1.15)	10.0%	20.0%	40.0%	20.0%	10.0%
Ability to perform flap harvesting	2.60 (1.07)	20.0%	20.0%	40.0%	20.0%	0.0%
Ability to perform microsurgical anastomosis	2.10 (1.10)	40.0%	20.0%	30.0%	10.0%	0.0%
Ability to manage complications of microsurgery	1.80 (0.92)	40.0%	50.0%	0.0%	10.0%	0.0%

Fig. 1. Self-reported precourse confidence level with various microsurgical skills. This figure demonstrates participant Likert ratings as a heat map. Participants were asked to rate their precourse level of confidence in each of the listed theoretical and technical microsurgery skills on a five-point Likert scale, with 1 representing not at all confident and 5 representing extremely confident. Mean (SD) and percentage rank distribution are displayed.

	Mean (SD)	Very Poor	Somewhat Poor	Neutral	Very Good	Excellent
Course setup/equipment	4.00 (0.71)	0.0%	0.0%	20.0%	60.0%	20.0%
Telementoring format	3.80 (0.84)	0.0%	0.0%	20.0%	40.0%	20.0%
Quality of instructor presentations	4.20 (0.45)	0.0%	0.0%	0.0%	80.0%	20.0%
Quality of instructor feedback	4.40 (0.55)	0.0%	0.0%	0.0%	60.0%	40.0%
Applicability to practice	4.20 (0.84)	0.0%	0.0%	20.0%	40.0%	40.0%
Time allocated to lectures	3.80 (0.84)	0.0%	0.0%	40.0%	40.0%	20.0%
Time allocated to skills sessions	4.00 (0.71)	0.0%	0.0%	20.0%	60.0%	20.0%
Utility of breakout sessions	4.40 (0.55)	0.0%	0.0%	0.0%	60.0%	40.0%
How well did this course meet your learning objectives	4.40 (0.55)	0.0%	0.0%	0.0%	60.0%	40.0%

Fig. 2. Postcourse feedback on quality of course elements. This figure demonstrates participant Likert ratings as a heat map. Participants were asked to rate the quality of each of the listed course elements on a five-point Likert scale, with 1 representing very poor and 5 representing excellent. Mean (SD) and percentage rank distribution are displayed.

Participants benefit from the convenience of in-home training at significantly reduced cost when considering travel and lodging, equipment, and material fees for comparable in-person courses. Mentorship and feedback from expert surgeons are of particular value given the availability of fewer than one plastic surgeon per one million people in participating countries.[2] The use of loupe magnification and provision of instruments, suture, and templates for practice models ensures reproducibility for self-directed practice to maintain newly acquired skills. Further, introductory-level skills courses can garner greater interest in expanding microsurgery capacity to participating regions and can set a foundation for further microsurgery training.

Conversely, microsurgery is a two-person, hands-on task, and it is impossible to replicate the subtleties of in-person coaching in a virtual setting. In our experience, minor technological and connectivity issues had significant impact on the participant and educator experience. Additionally, a virtual microsurgery skills course fails to address the issues of poor postoperative monitoring, skilled nursing, and resource availability that have hindered performance of microsurgery in certain LMICs.[1,7] Nonetheless, we report on these learner-identified deficiencies in the perioperative care of microsurgery patients to emphasize that a skills course alone is an early but incomplete step toward increasing microsurgery capacity in LMICs. As participants gain greater proficiency in technical microsurgery skills, we must prepare for the next steps in capacity building such as adding lectures on flap monitoring and salvage to the current course curriculum, developing a virtual curriculum for training of perioperative nursing staff, and engaging newer technologies such as virtual reality to bring remote telementoring into the operating room.[6]

Table 4. Self-reported Pre- and Postcourse Confidence with Various Microsurgery Skills

	Precourse Mean (SD)	Postcourse Mean (SD)	*P**
Theoretical Knowledge			
Indications for microsurgery	3.50 (0.97)	3.80 (0.84)	0.374
Appropriate flap selection	3.20 (1.03)	3.40 (1.14)	1.000
Perioperative monitoring/care	3.00 (1.15)	3.20 (1.10)	0.704
Medication use/role	2.90 (0.99)	3.20 (1.10)	0.374
Technical Skill			
Flap harvesting	2.60 (1.07)	3.60 (0.55)	0.374
Microsurgical anastomosis	2.10 (1.10)	3.20 (0.84)	0.071
Management of microsurgery complications	1.80 (0.92)	2.60 (1.14)	0.178

*Underpowered to detect significance.

Study Limitations

Limitations of this study include a small sample size and low secondary survey response rate, which may explain the lack of detectable difference in pre- and postcourse confidence scores. For this pilot study, participants were recruited from a finite pool of candidates who had previously been selected for the SHARE global fellowship (15 total fellows). Although there are relatively few plastic surgery trainees and junior surgeons in sub-Saharan Africa, we opted against an open recruitment strategy (eg, through COSECSA and other regional societies) to maintain an optimal 1:1 instructor to learner ratio based on the existing number of faculty involved with the SHARE organization. Secondly, we propose that the low response rate for the postcourse survey (50%) is due in part to loss of a

	Mean (SD)	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
Ideal instrument selection	4.20 (0.45)	0.0%	0.0%	0.0%	20.0%	80.0%
Vessel preparation and approximation	4.20 (0.45)	0.0%	0.0%	0.0%	80.0%	20.0%
Suture handling and technique	4.60 (0.55)	0.0%	0.0%	0.0%	40.0%	60.0%
Economy of motion and ergonomics	4.20 (0.45)	0.0%	0.0%	0.0%	80.0%	20.0%
End-to-end vessel anastomosis	4.40 (0.55)	0.0%	0.0%	0.0%	60.0%	40.0%

Fig. 3. Likert rating of perceived improvement in various technical and theoretical microsurgery skills following course completion. This figure demonstrates participant Likert ratings as a heat map. Participants were asked to what extent they agree that the microsurgery skills course improved their technical and theoretical knowledge of the listed objectives on a five-point Likert scale, with 1 representing strongly disagree and 5 representing strongly agree. Mean (SD) and percentage rank distribution are displayed.

captive audience, as the survey was deployed one week following the microsurgery course rather than immediately upon conclusion of the course. However, this response rate is consistent with our experience of prior survey deployments in this study population. Efforts to increase survey response rate include allotting 15 minutes at the end of the curriculum for structured feedback and incentivizing survey completion as a required criteria for course certification.

Finally, results were limited to subjective, learner-reported data due to technological challenges gathering video recordings and photographs for objective scoring. Nonetheless, objective skills assessments remain an essential tool for evaluating course efficacy. Challenges with technology and file storage can be easily circumvented by training course faculty to provide objective feedback during live breakout sessions using scoring tools such as the Global Rating Scale for Microvascular Anastomosis or Stanford Microsurgery and Resident Training Scale (SMaRT), which have been validated for use in similar settings.[8,9]

Virtual Microsurgery Skills Courses: Paving the Way for Future Iterations

In discussing this novel format for microsurgical skills training, we must stress the importance of obtaining learner input to guide course curriculum and design. Our needs assessment identified relatively high theoretical knowledge amongst participants and lower confidence with technical microsurgery skills, and participants ranked basic microsurgical skills as higher priority than more advanced techniques. Using this information, we designed the pilot course to use simple practice models and basic suturing techniques to match participant experience and ability. As microsurgery capacity in LMICs evolves, soliciting participant input before each course will remain an important step to ensure appropriate content and level of ability are represented in the course design.

Regarding course materials, a number of low-cost microsurgery training models have been described in the literature, including cardboard cutouts, latex gloves, surgical gauze, Japanese noodles, and chicken thigh vessels.[10–12] For our microvascular model, we selected the chicken thigh, given its affordability and accessibility, consistent anatomy, ideal vessel diameter, and demonstrated efficacy in improving microvascular skill across experience levels.[5,11] All participants had prior access to loupes for magnification, though mounted camera phones can be used as a cost-free alternative, as described by Ng et al.[12] Practice-grade microsurgery instrument kits and microsuture can be purchased at a low cost from online retailers and presented no issues in quality or functionality for skills training purposes.

Objective skills assessments were introduced after completion of the course and represent an important tool for evaluating course efficacy. Future iterations of the microsurgery curriculum will incorporate standardized pre- and postcourse performance assessments, using scoring tools that adhere to International Microsurgery Simulation Society Consensus prerequisites.[3] To increase participation in skills assessments, we suggest allotting 15 minutes at the start and end of the virtual course for completion of a scored, standardized task. Structured, summative feedback is an important adjunct to formative feedback provided during live skills sessions and helps to both signal course efficacy and guide independent practice.[13]

Participants unanimously agreed on the value of longitudinal feedback outside the 1-day skills course.

Longitudinal training and feedback opportunities take advantage of the principle of spaced learning, which has been correlated with improved learning efficiency and skill retention.[14] Although regular, one-on-one feedback sessions represent the highest yield format for longitudinal feedback, this is not a sustainable option given time zone differences and scheduling conflicts. We propose supplementing self-directed practice sessions with opportunities to submit video recordings or photographs for feedback, which provides greater flexibility for both the participant and educator. Examples of validated scoring tools that can be used in these contexts include the aforementioned Global Rating Scale for Microvascular Anastomosis for video-based submissions and the Anastomosis Lapse Index for photograph-based submissions.[8,15]

As with any new training model, early designs must be continually modified through an iterative process that incorporates participant feedback and trial-and-error. Our experience with a pilot virtual microsurgery course demonstrates the utility of virtual learning in the dissemination of surgical knowledge, training, and experience to our colleagues around the world.

CONCLUSIONS

The results of this study demonstrate a high frequency of microsurgical problems encountered by junior plastic surgeons in LMICs, yet inadequate training or patient care settings to perform these procedures. Therefore, a need exists for accessible, introductory microsurgery courses for plastic surgeons in these regions. Initial results from a pilot virtual microsurgery course demonstrate very high participant satisfaction and self-rated improvement in key microsurgical skills after course completion. These data support the utility of a virtual format for training novice microsurgeons in basic microsurgery skills while highlighting opportunities to improve future iterations.

Metasebia W. Abebe, MD, FC (ECSA), MPH
Plastic and Reconstructive Surgery
Saint Paul Hospital Millennium Medical College
Gulele Sub-City, PO Box 1271
Addis Ababa, Ethiopia
E-mail: mworku5@gmail.com

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Banda CH, Georgios P, Narushima M, et al. Challenges in global reconstructive microsurgery: the sub-Saharan African surgeons' perspective. *JPRAS Open*. 2019;20:19–26.
2. O'Flynn E, Andrew J, Hutch A, et al. The specialist surgeon workforce in east, central and southern Africa: a situation analysis. *World J Surg*. 2016;40:2620–2627.
3. Ghanem A, Kearns M, Ballestín A, et al. International microsurgery simulation society (IMSS) consensus statement on the minimum standards for a basic microsurgery course, requirements for a microsurgical anastomosis global rating scale and minimum thresholds for training. *Injury*. 2020;51:S126–S130.
4. Reghunathan M, Dean RA, Hauch A, et al. Virtual surgical subinternships: course objectives and a proposed curriculum. *Plast Reconstr Surg*. 2022;149:1032e–1040e.
5. Jeong HS, Moon MS, Kim HS, et al. Microsurgical training with fresh chicken legs. *Ann Plast Surg*. 2013;70:57–61.
6. Raborn LN, Janis JE. Overcoming the impact of COVID-19 on surgical mentorship: a scoping review of long-distance mentorship in surgery. *J Surg Educ*. 2021;78:1948–1964.
7. Citron I, Galiwango G, Hodges A. Challenges in global microsurgery: a six year review of outcomes at an East African hospital. *J Plast Reconstr Aesthet Surg : JPRAS*. 2016;69:189–195.
8. Atkins JL, Kalu PU, Lannon DA, et al. Training in microsurgical skills: does course-based learning deliver? *Microsurgery*. 2005;25:481–485.
9. McGoldrick RB, Davis CR, Paro J, et al. Motion analysis for microsurgical training: objective measures of dexterity, economy of movement, and ability. *Plast Reconstr Surg*. 2015;136:231e–240e.
10. Geoghegan L, Papadopoulos D, Petrie N, et al. Utilization of a 3D printed simulation training model to improve microsurgical training. *Plast Reconstr Surg Glob Open*. 2023;11:e4898.
11. Kania K, Chang DK, Abu-Ghname A, et al. Microsurgery training in plastic surgery. *Plast Reconstr Surg Glob Open*. 2020;8:e2898.
12. Ng ZY, Honeyman C, Lellouch AG, et al. Smartphone-based DIY home microsurgical training with 3D printed microvascular clamps and Japanese noodles. *Eur Surg Res*. 2023;64:301–303.
13. Gosman A, Mann K, Reid CM, et al. Implementing assessment methods in plastic surgery. *Plast Reconstr Surg*. 2016;137:617e–623e.
14. Teo WXW, Dong X, Yusoff SKBM, et al. Randomized controlled trial comparing the effectiveness of mass and spaced learning in microsurgical procedures using computer aided assessment. *Sci Rep*. 2021;11:2810.
15. Kim E, Norman ICF, Myers S, et al. The end game—a quantitative assessment tool for anastomosis in simulated microsurgery. *J Plast Reconstr Aesthet Surg*. 2020;73:1116–1121.