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SAGES VIRTUAL TELEMENTORING

At-home hands-on surgical training during COVID19: proof of concept using a virtual telementoring platform

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Abstract

Introduction Surgeons in practice have limited opportunities to learn new techniques and procedures. Traditionally, in-person hands-on courses have been the most common means for surgeons to gain exposure to new techniques and procedures. The COVID19 pandemic caused a cessation in these courses and left surgeons with limited opportunities to continue their professional development. Thus, SAGES elected to create an innovative hands-on course that could be completed at home in order to provide surgeons with opportunities to learn new procedures during the pandemic.

Methods This course was initially planned to be taught as an in-person hands-on course utilizing the Acquisition of Data for Outcomes and Procedure Transfer(ADOPT) method [1]. We identified a virtual telementoring platform, Proximie Ltd(London, UK), and a company that could create a model of an abdominal wall in order to perform a Transversus Abdominis Release, KindHeart™(Chapel Hill, NC, USA). The course consisted of pre-course lectures and videos to be reviewed by participants, a pre-course call to set learning goals, the hands-on telementoring session from home, and monthly webinars for a year.

Results The ADOPT hands-on hernia course at home was successfully completed on October 23rd of 2020. All participants and faculty were successfully able to set up their model and utilize the telementoring platform, but 15% required assistance. Post course-surveys showed that participants felt that the course was successful in meeting their educational goals and felt similar to prior in-person courses.

Conclusions SAGES was successfully able to transition and in-person hands-on course to a virtual at-home format. This innovative approach to continuing professional development will be necessary during the times of the COVID19 pandemic, but may be a helpful option for rural surgeons and others with travel restrictions in the future to continue their professional development without the need to travel away from their practice.

Keywords Education · Mentorship · Hernia · Continuing Professional Development · Technology Enhanced Learning · COVID19

Historically, surgeons have had limited opportunities to learn and incorporate new techniques into their practice following completion of training. Hands-on training courses have provided critical educational opportunities to introduce practicing surgeons to new techniques. Previous studies have shown that surgeons who attend a one-day training course are more likely to incorporate the learned procedure into their practice [1]. Additionally, formal train-the-trainer courses for faculty members and a prolonged period of post-course mentorship for attendees have led to increased surgeon confidence and number of learned procedures performed by course attendees [2–6].

The worldwide pandemic created by the COVID19 virus has led to dramatic changes in the way that practicing surgeons can continue their education and professional development. The conversion to virtual meetings, inability to travel, and need for social distancing have put a halt to many of the educational opportunities normally available to surgeons in practice. Additionally, financial constraints of hospitals and

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industry partners, as well as the increasing need to provide surgical and medical care during the pandemic, have forced many surgeons to remain within their communities and continue to work without the opportunity to focus on their own education. Despite these limitations, there remains a strong desire for practicing surgeons to continue their professional development.

The annual meeting of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) has historically included multiple hands-on courses focusing on the acquisition of new techniques and procedures to facilitate continuing professional development for surgeons in practice. Due to the pandemic, SAGES decided to delay its April 2020 Annual Meeting to August 2020 and convert it to a virtual format. Such a change precluded the delivery of in-person hands-on courses. Given this challenge, as well as the likelihood of a prolonged inability to host in-person training sessions, the organizers of the SAGES hands-on course for incisional hernia repair for the 2020 Annual Meeting decided to leverage new technology and procedural models to offer a distance course for surgeons in which they participated from their place of residence. In this manuscript, we describe the initial experience of this innovative and novel format for a hands-on course at home for incisional hernia repair.

Methods

The success of implementing a hands-on course for incisional hernia repair required melding available technology, preparation, faculty development, and educational delivery into an innovative, deliverable, and accessible product for the learners.

Available technology

Remote mentoring

In order to provide distance learning to participants in the hands-on course similar to its in-person version, faculty needed access to a remote mentoring platform capable of allowing meaningful one-on-one interaction with the learner. After evaluating several options, we chose an existing telementoring platform from Proximie Ltd (London, UK) intentionally designed for intraoperative surgical mentoring and education. It an augmented reality (AR) platform designed for use in both high- and low-resource environments. It can function over low-speed internet connections and is compatible with almost any electronic device having a camera component. With the camera pointed at the target of interest, the mentor and mentee can concordantly view its image in real-time on their respective devices. An AR interface allows the mentor to provide precise telestration that appears on the mentee's screen. Additional benefits of the Proximie platform include easy recording for review of sessions, and the ability to create a personalized "home page" for the course housing uploaded pre-course educational materials and videos for easy access. To ensure that the participants had the necessary hardware for using the Proximie platform for telementoring during the course, each participant received from the organizers a webcam with a gooseneck camera stand. The participants used their own laptop or tablet for the course. In addition, they needed to provide appropriate lighting for the instruction. Finally, the organizers instructed the participants, who were all practicing surgeons, to obtain a basic instrument set for the course through their home institution.

Operative model

The original in-person course was to employ a human cadaveric model to teach tissue-based approaches for inguinal hernia repair as well as anterior (i.e., external oblique) and posterior (i.e., transversus abdominis) component separations with retromuscular mesh placement for ventral hernia repairs. With the conversion of the course to a virtual format, we elected to focus solely on anterior and posterior component separations for ventral/incisional hernia repair. The operative model, therefore, needed to satisfy several critical criteria for use in this distance learning course: (1), close fidelity to the anatomy of the human abdominal wall, (2) portability, (3) affordability, (4) ability to be easily shipped and discarded after use. Of three companies having an operative model satisfying these criteria, we elected to work with KindHeart™ (Chapel Hill, NC, USA). KindHeart's existing technology utilizes porcine tissue to fabricate models for cardiac, thoracic, general, and bariatric surgery. After discussions about our needs, the company customized a porcine abdominal wall model that incorporated the necessary musculature and fascial layers needed to teach the operative techniques. This model also included a bespoke trainer box to secure the tissue specimen and allow for self-retraction during the procedure.

Implementation of hands-on course

Preparation

Approximately one month before the hands-on event, the course directors conducted a test-run of the KindHeart model and Proximie platform in which one took on the role of faculty instructor and the other acted like a participant learner. This pilot allowed for troubleshooting the telementoring technology and obtaining feedback on the operative model. Overall, both the telementoring platform and the

operative model worked well for this initial trial, although we did make some subtle changes to the operative model.

Faculty development

Consistent with all SAGES year-long ADOPT (Acquisition of Data for Outcomes and Procedure Transfer) programs, all faculty participated in the Laparoscopic Colectomy Train the Trainer (Lapco TT) course focusing on best practices for intraoperative teaching, taken before teaching hands-on hernia [7]. In addition, several weeks prior to the Hernia@Home course, a web meeting orientation session for faculty reviewed the course objectives, conduct of the course, and use of the augmented reality interface.

Course format

Email communication instructed the participants on how to access their Proximie accounts, where the pre-course material was located. This site also included videos on how to set up the operative model and its trainer box at home and how to use the telementoring interface. A week prior to the hands-on event, a group web meeting was conducted to introduce all faculty and mentees. The faculty members and learners then went to breakout "rooms" to perform the SET, the pre-operative discussion that delves into each participant's background and establishes each person's individual learning objectives for the course.

In the week prior to the course, the customized trainer box, which also contained donated mesh and suture, was shipped to each participant at their preferred location. Two days prior to the course, the abdominal wall porcine tissue model, vacuum sealed in preservative and frozen, was sent via expedited delivery service to each participant. On the day of the course, each faculty/learner trio arranged timing that was agreeable for all three participants. The learners were instructed to set up their boxes, suspend the tissue specimen, and arrange the webcam and monitor device an hour prior to the start of teaching. The faculty then guided each learner through the abdominal wall hernia repair/s that matched the learner's specific learning objectives. As the learner operated, the faculty could visually guide the proceedings by telestrating onto the learner's monitor. The non-operating mentee was also able to see and audibly interact during this time. After the first learner completed their dissection and repair, the session with the second learner commenced. At the conclusion of each session, a debriefing event was held between the faculty and mentee.

Evaluation

Upon completion of the hands-on course, each participant received a post-session survey evaluating its effectiveness. This 13-item questionnaire used a 5-point Likert scale (1 = definitely no to 5 = definitely) to evaluate instructors, the operative model, and technology. Frequency counts were determined for each item. In addition, participants who had taken a prior in-person hands-on had the opportunity to provide written comments about the course.

Results

The timeline for the virtual hands-on hernia course is shown in Fig. 1. On October 23rd, 2020 the hands-on course was held for all course attendees and faculty. Each faculty

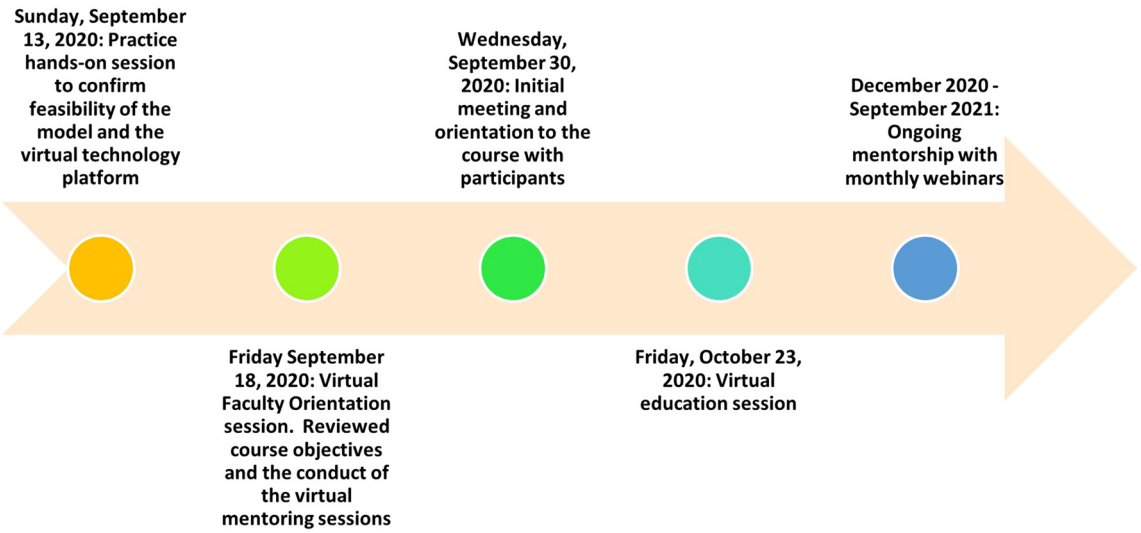

Fig. 1 Timeline for the Virtual Hands-On Hernia Course

member was responsible for 2 surgeon attendees and held one-on-one sessions with each attendee individually. Each surgeon attendee was encouraged to attend both of the one-on-one sessions to increase their exposure to the procedures.

Fifteen surgeons and an additional eight faculty members participated in the hands-on activities offered in the course. Two additional surgeons participated in the virtual mentoring sessions but were unable to be shipped inanimate models as they lived outside of the United States. The hands-on sessions lasted between 38 and 190 min (average session time = 96 min).

The post-course survey was completed by 14/15 (93%) of course attendees. Of those that completed the survey, 93% had reviewed the video library and completed the pre-course materials in advance of the hands-on session. All respondents felt that their instructor and they had established individualized learning goals in advance of the hands-on session. Individual educational goals for the course varied between learners. These goals included indications and approaches for different types of abdominal wall reconstruction, increasing comfort with component separation techniques, steps of the procedure, anatomy of both anterior and posterior dissections, and identification of a surgical mentor to help with future cases. Additionally, one respondent wanted to learn how a virtual hands-on course would be conducted.

All respondents received their porcine model, webcam, and trainer box in time for the hands-on course. Twelve participants (85%) were able to set up the telementoring connection without issue, while the remaining two (15%) required support from Proximie personnel to establish their connection on the day of the hands-on course. Among logistical challenges related to the course, 26% (4/14) had none, 21% (3/14) noted challenges with lighting and camera positioning, 21% (3/14) had issues logging into the platform, 21% (3/14) had difficulty coordinating their schedule due to clinical responsibilities, and 7% (1/14) had difficulty obtaining surgical instruments.

Representative images from the hands-on session are shown in Figs. 2 and 3. Course attendees were surveyed regarding the educational quality of the course as well as quality of the porcine model and the virtual telementoring platform (Table 1). All attendees found the porcine model to be valuable to the learning experience, while 93% (13/14) found the telementoring platform to be valuable as well. All course attendees felt that the virtual format was conducive to achieving their personal learning objectives and that the session was relevant to their professional development as a surgeon.

Ten of the course attendees (71%) had previously participated in a hands-on procedural course at some point in the past. When asked how this virtual hands-on course compared to prior experiences, their qualitative responses are

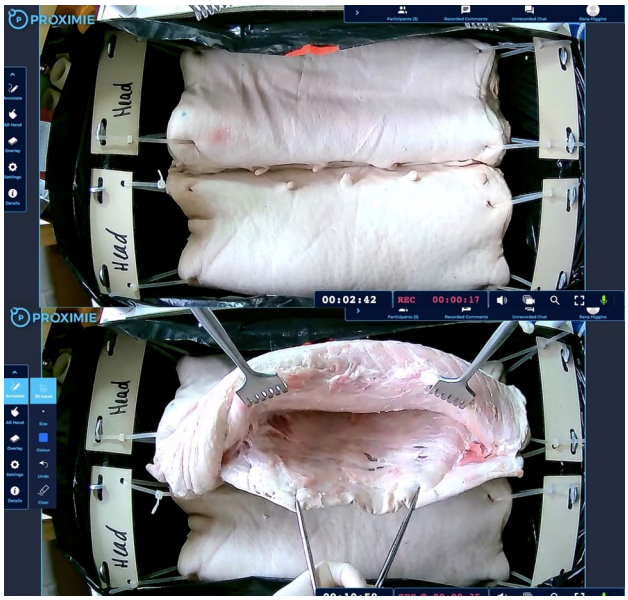

Fig. 2 Instructors view of the surgical field from their home computer

shown in Table 2. Overwhelmingly, participants felt that the virtual hands-on course compared favorably to prior experiences and in fact had several benefits. Benefits included lack of travel, decreased numbers of course participants per model, and increased time with the faculty mentor. While

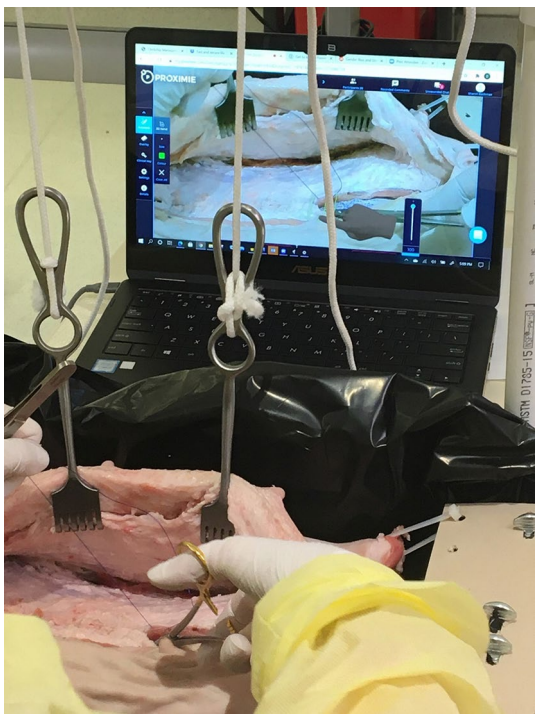

Fig. 3 Surgeons view of the surgical field with the porcine model and instructions provided via the computer

Table 1 Survey Results from the Hands-on Session

	1–Not at All %, (*n*)	2 %, (*n*)	3–Neutral %, (*n*)	4 %, (*n*)	5–Definitely %, (*n*)	Total (*n*)
At the beginning of the hands-on session, my instructor reviewed the educational plan for the session	0% (0)	0% (0)	0% (0)	7.1% (1)	92.9% (13)	14
The manner of instruction during the hands-on session was well-structured	0% (0)	0% (0)	0% (0)	7.1% (1)	92.9% (13)	14
I was allowed adequate time to ask questions during the training	0% (0)	0% (0)	0% (0)	0% (0)	100% (14)	14
My instructor was comfortable in silence when the task was going well	0% (0)	0% (0)	0% (0)	7.1% (1)	92.9% (13)	14
I achieved my personal learning objectives during the hands-on session	0% (0)	0% (0)	0% (0)	14.3% (2)	85.7% (12)	14
The style of instruction was helpful in achieving my objectives	0% (0)	0% (0)	0% (0)	0% (0)	100% (14)	14
My instructor provided feedback on my performance	0% (0)	0% (0)	7.1% (1)	0% (0)	92.9% (13)	14
My instructor asked me to provide feedback on my performance	0% (0)	0% (0)	7.1% (1)	7.1% (1)	85.7% (12)	14
I found the porcine model to be valuable to the learning experience	0% (0)	0% (0)	0% (0)	28.6% (4)	71.4% (3)	14
I found the Proximie telementoring platform to be valuable to the learning experience	7.1% (1)	0% (0)	0% (0)	7.1% (1)	85.7% (12)	14
I left the course with a clear take-home message	0% (0)	0% (0)	0% (0)	7.1% (1)	92.9% (13)	14
The virtual format was conducive to achieving my personal learning objectives	0% (0)	0% (0)	0% (0)	7.1% (1)	92.9% (13)	14
The session was relevant to my professional development as a surgeon	0% (0)	0% (0)	0% (0)	0% (0)	100% (14)	14

Table 2 Evaluation Results: "How did this course compare to previous courses?"

The course was for this procedure in fact. This was a close parallel
Despite this being virtual and having to set it up myself, it all went extremely well if not better (because I didn't have to travel)
It was excellent. I think I prefer this course!
In some ways, better. Usually in-person courses have multiple people sharing a cadaver or porcine model. To have a full hour just dedicated to me and a mentor on my model was pretty unique and valuable. I don't think I've ever done an educational course with that much dedicated 1:1 time
In-person courses allow to have a "whole specimen" as compared to just a portion. As mentioned above, this is key when exploring the subxiphoid and retropubic spaces
I felt more comfortable in this one. It actually seems more personalized. In the in-person courses, it seemed like a lot more distracting activity was going on
Previous courses have been designed by creating a group of 4–6 participants per station or cadaver. This has the potential to dilute the proctor's time and you may walk out with the feeling that you did not get the full potential of the experience. With today's experience it was a one to one experience and of course it felt that the whole thing was tailored to your specific needs
Very similar

some challenges were noted, mostly the need to set up and clean up, all respondents felt that they would recommend this course to a colleague.

Discussion

Our results demonstrate that it is feasible to conduct a hands-on surgical education course for ventral incisional hernia repair via distance learning utilizing a porcine model and a currently available telementoring platform. Further, we

found that the overwhelming majority of course participants felt that the educational experience was similar to in-person hands-on courses that they had completed in the past. Additionally, our study shows that surgeons can continue to achieve their goals around professional development during the SARS-Cov19 pandemic. This novel course can serve as a template for other organizations, including surgical societies and industry partners, to convert other hands-on training courses to a virtual format.

Historically, surgeons have learned the majority of the procedures they perform in practice during the residency training years, and more recently, through advanced fellowships. The introduction of minimally invasive surgery (MIS) in the 1980s forced an entire generation of surgeons in practice to adopt an entirely new technique with no prior exposure or training. As early adopters of MIS, SAGES became involved in disseminating this new surgical technique in an effective manner. To this end, they released a framework for post-residency surgical education and training [8]. The focus of this framework was to support surgeons to integrate techniques or procedures that are new to the individual surgeon to provide safe, high-quality patient care. In this framework, the authors describe key components to create successful hands-on courses, including the need for appropriately qualified faculty and participants, as well as a dedicated curriculum and means for assessment [8]. SAGES has subsequently updated its endorsement system for continuous professional development courses for practicing surgeons [9].

Hands-on courses have become a key component to procedural learning and adoption for physicians across multiple specialties and at all levels of training [10–13]. However, hands-on courses alone have not always led to successful procedural adoption for surgeons in practice. Zerey and colleagues found that the addition of a surgical expert to serve as a preceptor within the OR for the surgeon's initial independent cases led to significant improvements in procedural adoption [1]. In their survey study of 234 surgeons who had attended a hands-on course to learn laparoscopic ventral hernia repair, every surgeon who was precepted adopted the technique, while that adoption rate decreased to 58% for those who did not have a preceptor during their early independent experience [1].

More recently, many hands-on courses have been accompanied by a longitudinal mentoring program to enhance rates of procedural adoption. Dort and colleagues have previously implemented such a program during a prior hands-on hernia course sponsored by SAGES [2, 3]. In this course, participants had the options to participate in a standard one-day hands-on course taught by subject matter experts, or participate in the hands-on course followed by a year-long mentored experience taught by faculty members who were subject matter experts with specific training in the LapcoTT teaching method [7]. Three months following the course, the authors found that surgeons who participated in the year-long experience performed more ventral hernias repairs and had greater confidence with component separation techniques than those that just participated in the standard hands-on course. Greenberg and colleagues created a training curriculum utilizing simulation, precepting, and video-based surgical coaching to help facilitate adoption of laparoscopic inguinal hernia repair into practice [5]. While the curriculum was only completed by 2 out of 3 participants, both of the surgeons that completed the program had converted the majority of their inguinal hernia cases to minimally invasive approaches [5]. Our virtual hands-on course serves as the first step in an ongoing mentorship that will continue for one year beyond the course. We are hopeful that the results of this experience will be similar to SAGES sponsored hands-on courses that have utilized the ADOPT approach in terms of increased procedural volume and confidence for the surgeon participants [2–4]. However, in order for this course to be successful, the course chairs and faculty felt that it was crucial to provide the participants with a hands-on experience leading to the technology enhanced learning innovations. By providing a hands-on experience that is similar to an in-person course at home, faculty were able to ground participants in the nuances and technical aspects of the procedure, allowing them to focus their future learning efforts on implementation of the procedures into their own practice. Such learning would not have occurred without recreating the hands-on component of the course. In our course, we were successful in mimicking the one-on-one interaction of an in-person course by utilizing a novel porcine model and an online telementoring platform. In fact, participants who had taken prior in-person courses often felt that this particular online format was better suited for one-on-one teaching. While surgical telementoring was initially introduced in the 1960s, its use has been somewhat lacking historically [14]. Recent improvements in telementoring technology and renewed interest from surgical societies such as SAGES have led to significant improvements in the availability and effectiveness of telementoring as a means to promote professional development for surgeons in practice [14]. We were fortunate to be able to use this technology effectively as part of our at-home hands-on course.

While the impetus to convert to a virtual platform for this course was clearly the pandemic, we know that the benefits of virtual hands-on courses will likely remain well beyond the end of this pandemic. For surgeons in rural practice, time away from their hospital can lead to patients without access to care. Even in group practices, the stress and strain of travel can impact the work-life balance and wellness of those surgeons that must stay in their region in order to cover those that are away. Additionally, travel restrictions and decreasing budgets for travel reimbursement may lead surgeons in larger

practice settings to choose alternative options for continuing professional development where they exist. Thus, at-home hands-on courses could continue to provide surgeons with the capability to learn new techniques regardless of whether or not they are able to travel to do so.

While this study presents what is, to the best of our knowledge, the first-ever hands-on general surgery procedural course at home, it is not without its limitations. While the overall cost of the course was not significantly different from prior in-person courses, the course proved to be quite expensive. Costs to create and ship the models were substantial and could be an impediment to future courses. Additionally, we were unable to ship the models for addresses outside of the United States, which limited the ability for this course to draw international participation. Lastly, the administrative logistics of course planning was challenging as it required troubleshooting for a variety of issues at multiple different sites rather than all together at one location. However, none of these challenges proved to be insurmountable.

Conclusion

It is possible to replicate meaningful hands-on educational experiences for surgeons in a virtual format. As the longitudinal experience continues, we plan to follow the participants to gauge their procedural confidence and implementation of learned techniques into their practice and compare the effectiveness of this online format to prior in-person courses. Expansion of these courses beyond hernia surgery will help further demonstrate that at-home hands-on courses can successfully train surgeons in a variety of new procedures.

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Declarations

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