Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Miscellaneous

The Emergence of Collaboration in the Education of Fellows and Residents during COVID-19

Wayne E. Moschetti, MD, MS [a, *], Benjamin M. Frye, MD [b], Jeremy M. Gililland, MD [c], Andrew J. Braziel, MD, MS [d], Vivek M. Shah, MD [e]

[a] Department of Orthopaedics, Geisel School of Medicine, Dartmouth-Hitchcock Medical Center, Lebanon, NH
[b] Department of Orthopaedics, West Virginia University School of Medicine, Morgantown, WV
[c] Department of Orthopaedics, University of Utah School of Medicine, Salt Lake City, UT
[d] Department of Orthopedics, New England Baptist Hospital, Boston, MA
[e] Department of Orthopaedics, Brigham and Women's Hospital, Harvard Medical School, Boston, MA

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ABSTRACT

Background: COVID-19 has created a void in surgical education. Given social distancing and postponed surgeries, unique educational opportunities have arisen. Attendings from 10 adult reconstruction fellowships led a multi-institution web-based weekly collaborative, the Arthroplasty Consortium (AC), developed to educate trainees through complex arthroplasty case-based discussions.

Methods: We performed an anonymous survey of AC participants and American Association of Hip and Knee Surgeons (AAHKS) adult reconstruction fellows. Participants were polled with regards to educational tools used before and after COVID-19 and their value. Specifically, participation in the AC, AAHKS FOCAL (Fellows Orthopedic Continued AAHKS Learning) lectures, institutional lectures, industry lectures, textbooks, online videos, journal articles, and webinars was assessed.

Results: Fifty-seven participants responded with 49 (86%) at the fellow level. There was an increase in the use of web-based learning, including the AC (Not applicable pre, 61% post), AAHKS FOCAL lectures (Not applicable pre, 82% post), industry lectures (53% pre, 86% post), and AAHKS/AAOS webinars (35% pre, 56% post). Usage declined with institutional lectures (89% pre, 80% post), textbooks (68% pre, 49% post), and journal articles (97% pre, 90% post), with minimal change in the use of online surgical videos (84% pre, 82% post). The majority of fellows not involved in the AC would like to see the addition of a multi-institutional case conference added to fellowship education. Of AC participants, the 2 most valuable educational tools were the AC and FOCAL lectures.

Conclusion: Trainee education has changed post-COVID-19 with a greater focus on web-based learning. Multi-institutional collaborative lectures and case-based discussions have significant perceived value among trainees and should be considered important educational tools post-COVID 19.

Elective total hip and knee arthroplasties comprise the most commonly performed procedures in the United States, totaling more than 1 million cases annually. Arthroplasty is thus a procedure in high demand and in April 2020 there were 238 applicants for adult reconstruction (AR) fellowships in the United States with 189 positions filled [1]. The current worldwide COVID-19 pandemic led to the cancellation of many elective orthopedic surgical procedures, including total hip and knee arthroplasties [2]. These events have had profound impacts on trainee education. It is imperative that education of trainees continues during this time to assure that the next generation of arthroplasty surgeons are adequately trained to care for patients with hip and knee arthritis as well as complex arthroplasty needs which are rising at an exponential rate [3,4].

Over the past several years there has been a trend by orthopedic trainees toward electronic resources to gain knowledge and navigate standardized examinations [5]. This evolving trend will likely accelerate secondary to the in-person meeting constraints placed

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* Address correspondence to: Wayne E. Moschetti, MD, MS, Department of Orthopaedics, Geisel School of Medicine, Dartmouth-Hitchcock Medical Center, One Medical Center Drive, Lebanon, NH 03756.

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on training programs because of COVID-19. Electronic resource utilization in surgical training programs continues to expand and clearly represents another opportunity for trainees to develop their knowledge base [6]. Initially, the conflict between learning and providing care with that of the pressure to avoid exposure and illness was difficult to navigate [7]. Time away from the hospital led to an immediate reorganization of how most programs provided education and training to its residents and fellows. There was thus a transition away from typical in-person education to innovative forums for learning. Applications such as Zoom, WebEx, Google Classroom, and Microsoft Teams offer platforms for team-based collaboration beyond a single institution and across geographic regions [8–11]. Recorded content allows for the ability to revisit sessions for clarification and continued learning. Review of clinical materials such as case vignettes, radiographs, clinical references, and surgical techniques can now live in perpetuity and be viewed to reinforce and clarify topics beyond what was presented during the traditional "conference time." Early feedback suggests that attendance at these virtual conferences may be higher than normal and that feedback from participants is generally positive [12].

As healthcare resources have been redirected secondary to COVID-19, residency and fellowship programs have responded by adapting unique teaching methods, yet concerns exist regarding trainees obtaining adequate time for proper orthopedic education [13]. Secondary to the void created in surgical education by the COVID-19 pandemic, attending surgeons from 10 AR fellowships created a multi-institution web-based weekly collaborative, the Arthroplasty Consortium (AC), developed to educate trainees through case-based discussion on complex arthroplasty topics. Other resources being utilized during the COVID-19 pandemic include online surgical videos, and webinars from the American Association of Hip and Knee Surgeons (AAHKS), the American Academy of Orthopedic Surgeons (AAOS), and industry. In addition, AAHKS sponsored the Fellows Orthopedic Continued AAHKS Learning (FOCAL) collaborative lecture series. The study was aimed at assessing the value of these educational venues.

Methods

This cohort study involved all participants in the AC as well as all current AR fellows throughout the country regardless of participation in the AC. An anonymous survey of all participants in the AC (both fellows and residents) was administered electronically. The same survey, excluding questions specific to the AC, was administered by AAHKS to all AR fellows. RedCap was used to create the survey and securely collect and store the data. Demographic data were collected with regards to age, level of training, geographical area (Northeast, West, South, Midwest), and institution. Respondents were asked about their usage of various educational tools prior to and after COVID-19. The educational tools assessed included the AC, AAHKS FOCAL lectures, institutional didactic and case-based lectures, industry lectures and webinars, textbooks, online surgical videos (VuMedi, YouTube, AAOS Orthopedic Video Theater), journal articles, and AAHKS/AAOS webinars. Respondents were asked to rank the top 3 educational tools they felt to be most valuable during the COVID-19 pandemic. For those who participated in the AC, they were asked to rate aspects of the AC using a Likert scale from 1 to 5, with 5 being the best. Questions included the case complexity, faculty interaction with fellows, faculty interaction with other faculty, having faculty and fellows from multiple fellowship training programs, learning multiple methods and options for arthroplasty care, the age and experience of the faculty, the use of poll questions, and the use of the open chat function.

Open ended questions were used as an opportunity to obtain subjective feedback from the AC participants. The following questions were presented to the participants:

Do you feel that Fellow's Consortium Conferences have filled a void in your fellowship training due to COVID?
Do you feel the poll questions and chat function encouraged and facilitated your participation in Fellow's Consortium Conferences?
Did you learn new surgical techniques or reconstruction techniques you were not exposed to in your fellowship training by participating in the Fellow's Consortium Conference?
Would you be likely to continue participating in the Consortium after resolution of the COVID crisis?
Would you be likely to continue participating in the Consortium after completing your fellowship and during your first years of practice?
Based on your experience thus far with the Consortium, is there anything you would modify, add, or remove to improve the educational experience?

For AR fellows not participating in the AC, their level of interest in a case-based discussion run by faculty from various fellowships around the country was assessed. AR fellows were then asked what they would like to see added to their education and were presented the following options: industry supported lectures/webinars, AAHKS lectures, multi-institution collaborative case conference, and question banks. Survey data were tabulated and analyzed using descriptive statistics. Fisher's exact test was used to compare the educational tools utilized prior to and during the COVID-19 pandemic. Statistical significance was defined as a P value $< .05$.

Results

In total, 57 participants responded with 49 (86%) at the fellow level. There was a majority of respondents from the AC (35) compared to AAHKS AR fellows (22). The average age was similar between the 2 groups (AC 33.7 years, AR fellows 33.8). Of those participating in the AC, the majority were at the fellow level (77.1%; Table 1). There was a preponderance of fellows participating from the Northeast (AC 57.1%, AR fellows 36.4%; Table 1). Thirty-four different institutions were represented by participants responding to the surveys.

Overall, there was an increase in the use of web-based learning compared to before the COVID-19 pandemic. Neither the AC nor AAHKS FOCAL lectures were available prior to COVID-19, thus

Table 1
Baseline Demographics and Locations of Respondents From the Arthroplasty Consortium and AAHKS Adult Reconstruction Fellows.

	Arthroplasty Consortium (n = 35)	Adult Reconstruction Fellows (n = 22)
Average age	33.7 (SD = 2.7), range: 28-43	33.8 (SD = 2.9), range: 30-43
Level of training		
Fellow	27 (77.1%)	22 (100%)
PGY-5	5 (14.3%)	N/A
PGY-4	2 (5.7%)	N/A
PGY-3	1 (2.9%)	N/A
Geographical area		
Northeast	20 (57.1%)	8 (36.4%)
West	4 (11.4%)	3 (13.6%)
South	8 (22.9%)	5 (22.7%)
Midwest	3 (8.6%)	6 (27.3%)

AAHKS, American Association of Hip and Knee Surgeons; SD, standard deviation; PGY, post-graduate year; N/A, not applicable.

participation as expected was higher during COVID-19 ($P < .00001$). All participants surveyed from the AC cohort participated in the AC virtual meetings, while 83% of them attended the AAHKS FOCAL lectures (Table 2). Both industry lectures (53% pre, 86% post) and AAHKS/AAOS webinars (35% pre, 56% post) saw an increase in their usage during the COVID-19 pandemic yet only the change in industry lectures was significant for both the AC and AR cohorts ($P = .0029$, $P = .0459$ respectively). There was a decline noted in institutional didactic and case-based lectures (89% pre, 80% post), textbook use (68% pre, 49% post), and the use of journal articles (97% pre, 90% post). Minimal change was noted in the use of online surgical videos (84% pre, 82% post).

In assessing the value of each resource utilized during COVID-19, 22.9% of AC participants felt it was the most valuable tool while 74.3% felt it was in the top 3 most valuable resources. AAHKS FOCAL lectures were felt to be most valuable 45.7% of the time and were ranked in the top 3 62.8% of the time. The only other resource with more than half of participants ranking its value within the top 3 resources used during COVID-19 were institutional didactic and case-based lectures (51.4%). For AR fellows who did not participate in the AC, the AAHKS FOCAL lectures were deemed most valuable by 68.2% of the respondents and in the top 3 resources 90.1% of the time. Again, institutional didactic and case-based lectures were the only other resources ranked by more than half of respondents in the top 3 resources (59.1%).

For those who participated in the AC, the 3 aspects of the consortium which ranked highest were having faculty presenting from multiple institutions, exposure to multiple methods and options of arthroplasty care, and the complexity of the cases (4.4, 4.2, 3.9, respectively). For AR fellows asked what they would most like to see added to their education during fellowship 52.4% responded that they would like to see a multi-institutional collaborative case conference. After that 38.1% would like to see more AAHKS lectures.

In regards to the open ended questions the feedback was overwhelmingly positive. AC participants felt that the AC filled a void in fellowship training and promoted collaboration. Participants felt that continuing to participate in the AC would be valuable even into early practice. They appreciated the interactive nature of the conference and would like to see the addition of more cases and discussion about transition into practice and practice management.

Discussion

The COVID-19 pandemic will have lasting effects on orthopedic education. In-person didactic and case-based discussions will likely at some point return but the advent of web-based learning will undoubtedly have a long-term influence on the delivery of education for medical students, residents, and fellows. The findings of this study demonstrate a strong preference for the AC, AAHKS FOCAL lectures, and institutional didactic and case-based lectures during the COVID-19 pandemic. The methods of learning were deemed to be most valuable for trainees and have all leveraged innovative forums for learning. There have been several publications discussing the transition of education from traditional in-person venues to remote learning during COVID-19 but these have for the most part been single institutional series [14–16]. The current study represents a novel web-based, multi-institution, interactive, collaborative developed to educate trainees through case-based discussion on complex arthroplasty topics the likes of which have not been reported on previously. The goal of the AC was to not only fill a void in education during COVID-19 but to expand fellow education beyond one's own institution and promote collaboration.

The findings of this study as might be expected demonstrated an increase in the use of web-based learning compared to before the COVID-19 pandemic. The highest levels of participation were noted in the AC and the AAHKS FOCAL lectures, but we also saw an increase in industry lectures and AAHKS/AAOS webinars. This in part represents the shift to virtual content which has filled the void in education attributed to social distancing recommendations. Although videoconferencing technology is not new and has been used in other fields, there has clearly been an increase in its utilization for resident and fellow education [17,18]. Despite seeing an increase in web-based resource utilization it appears that participants found the most value in topic-based interactive educational tools such as the AC and AAHKS Focal lectures. This interactive style of learning has been reported to have increased popularity which may in fact promote better knowledge retention compared to traditional didactics [19]. This was supported by the current study with the majority of AR fellows who were not involved in the AC reporting they would like to see the addition of a multi-institutional case conference added to fellowship education. Of the AC participants, 74.3% felt it was in the top 3 most valuable resources while AAHKS FOCAL lectures were ranked in the top three 62.8% of the time.

In a study looking at resident, fellow, and attending perspective on e-learning during the COVID-19 pandemic, Essilfie et al [20] determined most trainees and attendings felt e-learning should continue to supplement education moving forward. In this study both attendings and trainees were more likely to favor multi-institutional learning with more than 75% of participants reporting educational interactions with other training programs and

Table 2
Educational Tools Utilized Prior to and During the COVID-19 Pandemic by Respondents From the Arthroplasty Consortium and AAHKS Adult Reconstruction Fellows.

	Arthroplasty Consortium (n = 35)			Adult Reconstruction Fellows (n = 22)		
	Used Prior to COVID-19	Used During COVID-19	*P*-Value	Used Prior to COVID-19	Used During COVID-19	*P*-Value
Arthroplasty consortium	N/A	35 (100%)	**<.00001**	N/A	N/A	N/A
AAHKS FOCAL lectures	N/A	28 (80.0%)	**<.00001**	N/A	19 (86.4%)	**<.00001**
Institutional didactic and case-based lectures	33 (94.3%)	29 (82.7%)	.2595	18 (81.8%)	17 (77.3%)	1
Industry lectures and webinars	15 (42.9%)	28 (80.0%)	**.0029**	15 (68.2%)	21 (95.5%)	**.0459**
Textbooks	24 (68.6%)	18 (51.4%)	.2223	15 (68.2%)	10 (45.5%)	.2231
Online surgical videos VuMedi/YouTube/AAOS Orthopedic Video Theater	28 (80.0%)	28 (80.0%)	>.99	20 (90.9%)	19 (86.4%)	>.99
Journal articles	34 (97.1%)	32 (91.4%)	.6139	21 (95.5%)	19 (86.4%)	.6069
AAHKS/AAOS webinars	9 (29.0%)	16 (45.7%)	.1338	11 (50%)	16 (72.7%)	.2152

Bold = Statistical significance was defined as a *P* value < .05.
AAHKS, American Association of Hip and Knee Surgeons; AAOS, American Academy of Orthopedic Surgeons; FOCAL, Fellows Orthopedic Continued AAHKS Learning; N/A, not applicable.

more than 65% participating in learning lectures. Trainees were more likely than attendings to participate and this supports the paradigm shift toward multi-institutional collaboration outlined by the AC. That study did not detail the specifics of multi-institutional collaboration and which aspects participants felt were most valuable like the current study has. Having varying faculty present from multiple institutions, exposure to multiple methods and options of arthroplasty care, and reviewing complex arthroplasty cases were ranked most highly.

The current study is not without limitations. Fifty-seven trainees responded to our survey with 49 at the fellow level. This is only a proportion of the total fellow population training through the COVID-19 pandemic, yet we believe this is a large enough cohort to get a sense of how learning patterns have shifted and where fellows find value in their education. In addition, both the AC and AAHKS FOCAL lectures emerged during the pandemic with minimal time to prepare and disseminate information to promote participation. Despite this, both these resources were ranked among the top resources fellows preferred. Certainly as time goes on one might anticipate these series become more popular and continue to grow their participation. Continuing Medical Education credit is now available for the AC which may also impact participation. We also saw a majority of participation from the Northeast which is likely related to the creation of the AC at institutions located in that region but by no means is participation regionally limited secondary to the virtual platform.

The COVID-19 pandemic has posed many challenges across the landscape of healthcare but may have served as an effective catalyst to expand educational opportunities. Trainee education has been one aspect which required adaptation and rethinking of many of the ways traditional education was communicated. Leveraging web-based technology and the creation of a multi-institutional case-based collaborative has demonstrated high value among trainees and will continue to supplement traditional fellowship education while providing a broadened scope to participants beyond that of their traditional training. Orthopedic surgery will always be a profession reliant on technical skills, yet the complement of web-based virtual learning will likely continue to play a bigger part in educating trainees.

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