

Perceptions of Saudi Plastic Surgery Residents and Attendings of Online Education during the COVID-19 Pandemic

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Background: The world has faced an unprecedented challenge in controlling the spread of COVID-19—a rapid reshaping of the healthcare system and education was inevitable. Consequently, residency programs adopted e-learning as a social distancing tool for the continuity of the learning process. In this study, we explore the opinions and perspectives of plastic surgery attending doctors and residents on the implications of e-learning.

Methods: After obtaining ethical approval, this cross-sectional study was conducted electronically between October and December 2020 among plastic surgery residents and board-certified plastic surgeons in Saudi Arabia. Participants completed a validated, anonymous, self-administered questionnaire. The questionnaire gathered participants' demographic data, perceptions of online webinars, and audiovisual evaluations. Finally, we compared traditional (in-person) teaching with online webinars. The analysis was performed at a 95% confidence interval using the Statistical Package for Social Sciences (SPSS), version 23.0 (IBM, Armonk, N.Y.).

Results: A total of 61 responses were included in this study. The majority of respondents (78.7%) were comfortable during webinars, with 38 (62.3%) believing they should supplement traditional teaching methods. Overall, 50.8% were satisfied with the webinars. However, 37.7% were neutral. Most believed that the webinars increased their clinical (67.2%) and surgical skills (67.2%) to reasonable levels.

Conclusions: Online education provided an excellent educational tool as a viable option to supplement traditional face-to-face training, with most residents being satisfied, supporting the use of this educational tool. More objective research is required to refine existing online plastic surgery teaching methods while creating novel distance e-learning approaches for the future. (*Plast Reconstr Surg Glob Open* 2021;9:e3658; doi: [10.1097/GOX.0000000000003658](https://doi.org/10.1097/GOX.0000000000003658); Published online 22 June 2021.)

INTRODUCTION

In December 2019, the novel coronavirus (COVID-19) was first reported in Wuhan, China.¹ Subsequently, the world has faced unprecedented challenges in controlling the spread of the infection, thereby, inevitably and

rapidly reshaping the healthcare system and education. Many rules and regulations have been implemented to minimize the spread of the virus, including social distancing through, among others, minimizing group gatherings in closed spaces. The Centers for Disease Control and Prevention recommended canceling any gatherings of 10 or more people.² In Saudi Arabia, to control the spread of the infection, all dental/cosmetic clinics were closed, and only emergency procedures were permitted.³ As a result, telemedicine was implemented for patient follow-up, and most centers adopted e-learning as a tool to adhere to social distancing and facilitate continued learning activities. Howlett et al defined e-learning as “the use of electronic technology and media to deliver, support, and enhance both learning and teaching... [it] involves communication between learners and teachers utilizing online content.”⁴ Essilfie et al explored the opinions of orthopedic trainees (residents) and attending doctors (attendings) in the USA, finding that most regarded

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e-learning's role in the education process as an adjunct to traditional methods.⁵ Mossa Elshimaa et al evaluated the extent to which Egyptian ophthalmologists' clinical and surgical skills improved using e-learning, with most participants requesting that webinars to continue, even after the initial wave of the pandemic.⁶ Thus, e-learning could be a fundamental tool in future surgical training curricula. This study explores the opinions and perspectives of plastic surgery residents and attendings and assesses the implications of e-learning for plastic surgery education.

METHODS AND MATERIALS

Ethical Considerations

This study was conducted after receiving ethical approval from the research ethics board of King Saud University Medical City, Riyadh, Saudi Arabia. The contributions of residents and attendings were voluntary. Before participation in the research, informed consent was gained from all participants.

Study Design and Data Collection

Our survey-based cross-sectional study was distributed between October 2020 and December 2020 among junior and senior plastic surgery residents in various training programs and board-certified attending plastic surgeons across Saudi Arabia. Respondents were identified by answering a question in the survey that determined their level. It was sent one time to each participant followed by one reminder message 2 days later. The 61 responses are unique and not duplicated, as respondents had to sign in with their emails to fill in the questionnaire.

Participants completed a validated, anonymous, self-administered questionnaire. All Saudi plastic surgery residents enrolled in the Saudi Commission for Health Specialties training programs in the central and western regions, together with board-certified attending plastic surgeons, were invited to participate in the study. Using an online sample calculator (Raosoft) with a 5% margin of error and a 95% confidence level, the estimated number of required participants was 45; thus, the 61 selected were considered a strongly representative sample.

Study Variables

The 19-question survey was developed using Google Forms software (USA) to capture participants' perceptions

and perspectives of online teaching during the COVID-19 pandemic. The survey was distributed via WhatsApp (Mountain View, Calif.).

The study evaluated online learning in the context of webinars in general. We defined online learning as any webinar where a speaker can communicate with audience via audio and/or video and share multimedia content with audiences, including presentation slides and videos online.

The questionnaire consisted of three sections. The first section captured demographic data, personal characteristics, and training details; the second section focused on the perceptions of online webinars during the coronavirus pandemic; and the third section included audiovisual evaluation and comparison questions between traditional (in-person) and online webinar teaching of plastic surgery. The survey involved multiple-choice questions assessed on a five-level Likert scale, combined with yes-no response items. The online survey was designed according to the research's targeted objectives following previously validated questionnaires with similar objectives and aims. A Cronbach's alpha test result of 0.826 confirmed the reliability of the questionnaire and its validity was confirmed using Spearman's product-moment test, whereby all the *P* values were less than the reference value (Table 1).

Statistical Analysis

Sociodemographic and webinar attendance related variables were presented as frequencies and percentages. Age was presented as mean \pm SD. The associations between gender, marital status, current position, and webinar attendance related variables were assessed using the Chi-square test. The Statistical Package for Social Science (SPSS), version 23.0 (IBM, Armonk, N.Y.) was used for performing the calculations, with a 95% confidence interval.

RESULTS

A total of 61 responses were included in this study: 41 (67.2%) were men, 28 (45.9%) were married, and 19 (31.1%) had children. Their current positions were as follows: board-certified plastic surgeons (34.4%), senior residents (26.2%), and junior residents (39.3%) (Table 2).

The mean age of all respondents was 33.18 (\pm 8.85) years. The majority of the respondents (78.7%) were comfortable during webinars, but fewer (49.2%) were comfortable asking questions during webinars compared with

Table 1. Validity Analysis by Spearman Product Moment Test

Items	Reference Value	<i>P</i>	Interpretation
Comfortable during online webinars compared with traditional lectures	0.250035	<0.001	Valid
Comfortable to ask questions and interact during online webinars compared with traditional lectures	0.250035	<0.001	Valid
Online webinars more useful compared with the traditional lectures	0.250035	<0.001	Valid
Online webinars should continue after COVID-19 pandemic	0.250035	<0.001	Valid
Interaction with the speaker	0.250035	<0.001	Valid
Session announcement	0.250035	<0.001	Valid
Easy access to session	0.250035	<0.001	Valid
The audiovisual quality	0.250035	<0.001	Valid
Overall satisfaction of the participants on the online webinar	0.250035	<0.001	Valid
In comparison, webinars to regular conferences, which is better?	0.250035	<0.001	Valid
To which extent webinars increased your clinical skills in diagnosis and management?	0.250035	<0.001	Valid
To which extent webinars increased your surgical skills and management of complications?	0.250035	0.001	Valid

Table 2. Socio-demographic Characteristics of All Respondents (n = 61)

Characteristics	Attributes	Frequency	Percentage
Gender	Men	41	67.2
	Women	20	32.8
Marital status	Married	28	45.9
	Unmarried	33	54.1
Having children	No	42	68.9
	Yes	19	31.1
Current position	Attending (board-certified plastic surgeon)	21	34.4
	Senior resident (PGY 4–6)	16	26.2
	Junior resident (PGY 1–3)	24	39.3
		45	73.8
Current region	Central	45	73.8
	Western	16	26.2

traditional classes. When asked if the webinars could be more useful than traditional classes, the opinions were uniformly distributed, 29.5% said no, 29.5% said yes, and the remaining 41.0% were undecided (maybe). The interaction with the speaker, session announcements, easy access to the session, and audiovisual quality was rated as excellent at 11.5%, 42.6%, 57.4%, and 24.6% of respondents, respectively. Most doctors—38 (62.3%)—believed that the webinars should be included in teaching, and overall, 50.8% of them were satisfied with the webinars. However, 37.7% were neutral. When asked whether webinars were better than regular conferences, they responded as follows: markedly worse (1.6%), worse (41.0%), same (31.1%), better (6.6%), and markedly better (19.7%). Twenty-five (41.0%) doctors reported that they usually lost concentration toward the end of the webinars. However, most doctors (67.2%) believed that the webinars increased their clinical and surgical skills to reasonable levels, although the lack of practical education was mentioned by 27 (44.3%) doctors (Table 3).

A total of 16 webinar-related questions are analyzed and presented in Table 4, showing the association between current position and webinar attendance related questions.

DISCUSSION

As the coronavirus pandemic spread globally,⁷ creating uncertainty over the future of social interaction, the Saudi plastic surgery residency program considered different teaching and learning options. Traditional in-person teaching methods were supplemented or replaced—due to strict social distancing rules—by internet-based teaching methods, thereby transforming education and learning in the medical field.^{7–11} This urgent shift was needed to boost the Saudi plastic surgery education program under circumstances in which the adaptation and utilization of technology in teaching and training would previously have been considered inappropriate.¹² As this teaching method is novel to plastic surgery residents and attendings in Saudi Arabia, it constitutes the main objective of this research. We thus established their preference for—and associated strengths and weaknesses of—the online teaching method during the pandemic, while evaluating the extent to which webinars improved their overall knowledge and whether they should continue once this pandemic is over.

In our study, senior residents were more comfortable to ask questions and interact during online webinars (81.3%) than junior residents (16.7%), with a statistically significant difference ($P < 0.001$). This could be attributed to the fact that senior residents have obtained enough skill and knowledge throughout their training years to interact with speakers comfortably. On the other hand, only 61.9% of board-certified plastic surgeons were comfortable asking and interacting during online webinars, and this could be because they are more used and more familiar with the traditional way of teaching. Regarding the opinion of participants of the online webinar as an educational tool, more than half of board-certified plastic surgeons (52.4%) agreed that it should be independent of the curriculum rather than replace it or be part of it ($P < 0.001$), this could be attributed to the fact that in this way they will know the residents and will be able to evaluate their strengths and weaknesses better, act as mentors, and guide them through their training in person. On the other hand, all of the senior residents (100%) and the majority of juniors (70.8%) said that online teaching should be an adjacent tool to traditional teaching ($P < 0.001$), as this will allow them to get the advantages of both traditional teachings via learning and practicing different skills, maintain interpersonal relationship and online teaching with its time flexibility and easiness of storing and documenting information in an online database. The majority of board-certified plastic surgeons (52.4%), seniors (100%), and juniors (83.3%) reported that their main interest in a webinar is due to the topic itself ($P < 0.001$). This could be attributed to the fact that by knowing the topic, participants will be able to prepare it in advance and thus make the discussion more interactive.

Our study's results showed that residents and attendings (78.7%) were comfortable attending webinars, while fewer (49.2%) were comfortable asking questions during webinars compared with traditional lectures. In addition, 44.3% of the respondents agreed that online webinars should continue once the pandemic is over, indicating the need to adjust our educational delivery for an extended time, given the unpredictability of this pandemic and other future pandemics.

Zoia et al reported the effect of the pandemic on neurosurgery residents' education and training in Italy, showing its significant effect on training while indicating that the prompt response of attendings mitigated this impact. Their response ranged from reducing working hours to maintaining safety during emergency surgical exposure. In addition, they alternated the reduced operative and clinical duties with more educational and scientific activities.¹³

Of our participants, 67.2% and 60.7% answered "good" for the role of online education in improving clinical and surgical skills, respectively, which implies they perceived some benefit, consistent with Ebner et al and Gegenfurther et al, who also found this in their meta-analysis.¹⁴ Various residency programs in North America and Europe have developed similar approaches.^{12,13,15,16} In a Chilean study, Figueroa et al found that 86% of orthopedic residency programs have initiated the use of online teaching during the

Table 3. Webinar Attendance-related Questions and Answers

Questions	Answers	N	%
Comfortable during online webinars compared with traditional lectures	○ No	1	1.6
	○ Maybe	12	19.7
	○ Yes	48	78.7
Comfortable to ask questions and interact during online webinars compared with traditional lectures	○ No	10	16.4
	○ Maybe	21	34.4
	○ Yes	30	49.2
Online webinars more useful compared with the traditional lectures	○ No	18	29.5
	○ Maybe	25	41.0
	○ Yes	18	29.5
Online webinars should continue after COVID-19 pandemic	○ No	12	19.7
	○ Maybe	22	36.1
	○ Yes	27	44.3
Interaction with the speaker	○ Poor	5	8.2
	○ Average	49	80.3
	○ Excellent	7	11.5
Session announcement	○ Poor	16	26.2
	○ Average	19	31.1
	○ Excellent	26	42.6
Easy access to session	○ Poor	1	1.6
	○ Average	25	41.0
	○ Excellent	35	57.4
The audiovisual quality	○ Poor	3	4.9
	○ Average	43	70.5
	○ Excellent	15	24.6
The opinion of the participants regarding the online webinar as an educational tool	○ Should be independent of the curriculum	14	23.0
	○ Should be part of teaching (adjacent tool)	38	62.3
	○ Should replace current teaching method	9	14.8
Overall satisfaction of the participants on the online webinar	○ Not satisfied	7	11.5
	○ Neutral	23	37.7
	○ Satisfied	31	50.8
Your interest in webinar is due to	○ CME hours	10	16.4
	○ Institute/company	1	1.6
	○ The speaker	3	4.9
In comparison, webinars to regular conferences, which is better?	○ The topic	47	77.0
	○ Markedly worse	1	1.6
	○ Worse	25	41.0
Your concentration and attention on the webinar were maintained until it ended	○ Same	19	31.1
	○ Better	4	6.6
	○ Markedly better	12	19.7
To which extent webinars increased your clinical skills in diagnosis and management?	○ Always to the end	6	9.8
	○ Usually to the end	25	41.0
	○ Sometimes to the end	18	29.5
To which extent webinars increased your surgical skills and management of complications?	○ Rarely to the end	9	14.8
	○ Never to the end	3	4.9
	○ Bad	9	14.8
What difficulties do you see with this form of education?	○ Good	41	67.2
	○ Very good	9	14.8
	○ Excellent	2	3.3
In comparison, webinars to regular conferences, which is better?	○ Bad	18	29.5
	○ Good	37	60.7
	○ Very good	5	8.2
What difficulties do you see with this form of education?	○ Excellent	1	1.6
	○ Lack of concentration due to in-home distractions	5	8.2
	○ Lack of practical education	27	44.3
What difficulties do you see with this form of education?	○ Overload of seminars/presentations	7	11.5
	○ Scheduling	1	1.6
	○ Technical issues (slow connection, audio quality)	21	34.4

pandemic.¹⁷ In our study, the online education model had an acceptable satisfaction rate (50.8%). Most of our respondents (44.3%) wanted to continue online educational platforms after this pandemic. These 2 findings agree with a study with similar objectives conducted among neurosurgery residents and attendings.¹⁸ Despite the interest in online education stemming from its convenience and ease of access, our findings still demonstrate the importance and value of traditional face-to-face educational methods.

As young millennials—mean age of 33.18 years—most of our respondents prefer multitasking, collaborative work, and, more importantly, are very comfortable using technology and the internet.^{19–21} Our findings are consistent with generational learning theories, in that residents were more satisfied with the novel method of online education than their board-certified surgeon colleagues. Hence, the use and incorporation of online educational tools in the near future, as part of the primary teaching method in surgical

Table 4. Association between Current Position and Webinar Attendance Related Questions

Item No.	Questions	Answers	Board Certified Plastic Surgeon (%)	Senior Resident (%)	Junior Resident (%)	P
1	Comfortable during online webinars compared with traditional lectures	o No	0.0	0.0	4.2	0.614
		o Maybe	19.0	12.5	25.0	
		o Yes	81.0	87.5	70.8	
2	Comfortable to ask questions and interact during online webinars compared with traditional lectures	o No	9.5	0.0	33.3	<0.001
		o Maybe	28.6	18.8	50.0	
		o Yes	61.9	81.3	16.7	
3	Online webinars more useful compared with the traditional lectures	o No	28.6	18.8	37.5	0.557
		o Maybe	47.6	50.0	29.2	
		o Yes	23.8	31.3	33.3	
4	Online webinars should continue after COVID-19 pandemic	o No	4.8	18.8	33.3	0.029
		o Maybe	33.3	56.3	25.0	
		o Yes	61.9	25.0	41.7	
5	Interaction with the speaker	o Poor	9.5	0.0	12.5	0.089
		o Average	66.7	93.8	83.3	
		o Excellent	23.8	6.3	4.2	
6	Session announcement	o Poor	47.6	0.0	25.0	<0.001
		o Average	28.6	12.5	45.8	
		o Excellent	23.8	87.5	29.2	
7	Easy access to session	o Poor	0.0	0.0	4.2	0.034
		o Average	52.4	12.5	50.0	
		o Excellent	47.6	87.5	45.8	
8	The audiovisual quality	o Poor	0.0	0.0	12.5	0.201
		o Average	76.2	75.0	62.5	
		o Excellent	23.8	25.0	25.0	
9	The opinion of the participants regarding the online webinar as an educational tool	o Should be independent of the curriculum	52.4	0.0	12.5	<0.001
		o Should be part of teaching (adjacent tool)	23.8	100	70.8	
		o Should replace current teaching method	23.8	0.0	16.7	
10	Overall satisfaction of the participants on the online webinar	o Not satisfied	33.3	0.0	0.0	<0.001
		o Neutral	14.3	12.5	75.0	
		o Satisfied	52.4	87.5	25.0	
11	Your interest in webinar is due to	o CME hours	47.6	0.0	0.0	<0.001
		o Institute/company	0.0	0.0	4.2	
		o The speaker	0.0	0.0	12.5	
12	In comparison, webinars to regular conferences, which is better?	o The topic	52.4	100	83.3	0.005
		o Markedly worse	0.0	6.3	0.0	
		o Worse	23.8	68.8	37.5	
13	Your concentration and attention on the webinar were maintained until it ended	o Same	52.4	6.3	29.2	0.001
		o Better	0.0	0.0	16.7	
		o Markedly better	23.8	18.8	16.7	
14	To which extent webinars increased your clinical skills in diagnosis and management?	o Always to the end	23.8	0.0	4.2	0.015
		o Usually to the end	14.3	62.5	50.0	
		o Sometimes to the end	52.4	18.8	16.7	
15	To which extent webinars increased your surgical skills and management of complications?	o Rarely to the end	9.5	6.3	25.0	<0.001
		o Never to the end	0.0	12.5	4.2	
		o Bad	23.8	0.0	16.7	
16	What difficulties do you see with this form of education?	o Good	76.2	68.8	58.3	0.083
		o Very good	0.0	25.0	20.8	
		o Excellent	0.0	6.3	4.2	
16	What difficulties do you see with this form of education?	o Bad	33.3	93.8	45.8	<0.001
		o Good	66.7	0.0	33.3	
		o Very good	0.0	0.0	20.8	
		o Excellent	0.0	6.3	0.0	
		o Lack of concentration due to in-home distractions	23.8	0.0	41.7	
16	What difficulties do you see with this form of education?	o Lack of practical education	42.9	50.0	0.0	0.083
		o Overload of seminars/presentations	9.5	12.5	12.5	
		o Scheduling	0.0	0.0	4.2	
		o Technical issues (slow connection, audio quality)	23.8	37.5	41.7	

specialties, requires further research to establish its success in fostering knowledge retention and overall participants' satisfaction. Numerous articles on medical training programs across various specialties and their technical considerations for online education have been published during the coronavirus pandemic. Odedra et al measured

the impact of the pandemic on Canadian radiology residency training programs, where residents preferred online educational webinars, with an overall 95.3% satisfaction rate.²² In this study, we found a marked preference for online education with the possibility for the audience to engage and participate. Even though online education

and presentations were widely used globally before the pandemic, it has now been reinforced as a brilliant teaching method due to being more effectively integrated with current resources. Online education technology is readily available, beneficial, and inexpensive for Saudi plastic surgeons, as a supplemental tool to traditional educational methods.

Limitations

This study has various limitations, including the study's descriptive cross-sectional nature and the probability of bias. In addition, even though the response rate among residents was almost 90%, among attendings it was only 64%. This might be explained by the fact that the questionnaire was distributed over a short time, and also lack of time and interest by attendings to complete the questionnaire. We also assessed the efficacy of online education subjectively through the questionnaire's answers. Further research is needed for objective assessment, before and after testing, to evaluate participants' knowledge and skills.

Another significant limitation is that this study was conducted during the period of the coronavirus pandemic. Thus, results are confined to a certain period of time under circumstances of banned gatherings by the government in an attempt to decrease spread of the virus. Therefore, it cannot be generalized to times before the COVID-19 pandemic. More studies should be conducted once surgical operations and clinical duties have returned to their regular schedules.

CONCLUSIONS

During the coronavirus pandemic, online educational tools proved viable in supplementing the traditional (face-to-face) educational approach. More objective research and progress is required in adopting and refining existing online plastic surgery teaching methods while developing novel and engaging distance-learning methods for the future.

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REFERENCES

- Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med*. 2020;382:1199–1207.
- Centers for Disease Control and Prevention. Get your mass gatherings or large community events ready for Coronavirus disease 2019. Available at <https://www.cdc.gov/coronavirus/2019-ncov/community/large-events/mass-gatherings-ready-for-covid-19.html>. Published 2020. Accessed January 10, 2021.
- Al Saud NA, Alanazi SN, Alshomer FM, et al. Plastic surgery and COVID-19 in the GCC: fears, lessons learned, and the plan for the future. *Plast Reconstr Surg Glob Open*. 2020;8:e3225.
- Howlett D, Vincent T, Gainsborough N, et al. Integration of a case-based online module into an undergraduate curriculum: what is involved and is it effective? *E-Learn*. 2009;6:372–384.
- Essilfie AA, Hurley ET, Strauss EJ, et al. Resident, fellow, and attending perception of E-learning during the COVID-19 pandemic and implications on future orthopaedic education. *J Am Acad Orthop Surg*. 2020;28:e860–e864.
- Mossa E, Mohammad A, Alahmady H. On line webinars during time of COVID-19: does it increase the clinical and surgical skills of Egyptian ophthalmologists? *J Clin Res Ophthalmol*. 2020;7:075-080.
- World Health Organization (WHO). Coronavirus disease (COVID-19) pandemic. Available at <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>. Published 2020. Accessed April 14, 2020.
- Odedra D, Chahal BS, Patlas MN. Impact of COVID-19 on Canadian radiology residency training programs. *Can Assoc Radiol J*. 2020;71:482–489.
- Carter BS, Chiocca EA. Editorial. COVID-19 and academic neurosurgery. *J Neurosurg*. 2020;133:8–9.
- Bajunaid K, Alqurashi A, Alatar A, et al. Neurosurgical procedures and safety during the COVID-19 pandemic: a case-control multicenter study. *World Neurosurg*. 2020;143:e179–e187.
- Stambough JB, Curtin BM, Gililand JM, et al. The past, present, and future of orthopedic education: lessons learned from the COVID-19 pandemic. *J Arthroplasty*. 2020;35(7S):S60–S64.
- Sabharwal S, Ficke JR, LaPorte DM. How we do it: modified residency programming and adoption of remote didactic curriculum during the COVID-19 pandemic. *J Surg Educ*. 2020;77:1033–1036.
- Zoia C, Raffa G, Somma T, et al. COVID-19 and neurosurgical training and education: an Italian perspective. *Acta Neurochir (Wien)*. 2020;162:1789–1794.
- Gegenfurtner A, Ebner C. Webinars in higher education and professional training: a meta-analysis and systematic review of randomized controlled trials. *Educ Res Rev*. 2019;28:100293.
- Adesoye T, Davis CH, Del Calvo H, et al. Optimization of surgical resident safety and education during the COVID-19 pandemic – lessons learned. *J Surg Educ*. 2021;78:315–320.
- Low JCM, Rowland D, Kareem H. L1/2 intradural disc herniation with compression of the proximal cauda equina nerves: a surgical challenge. *World Neurosurg*. 2020;142:147–151.
- Figueroa F, Figueroa D, Calvo-Mena R, et al. Orthopedic surgery residents' perception of online education in their programs during the COVID-19 pandemic: should it be maintained after the crisis? *Acta Orthop*. 2020;91:543–546.
- Al-Ahmari AN, Ajlan AM, Bajunaid K, et al. Perception of neurosurgery residents and attendings on online webinars during COVID-19 pandemic and implications for future education. *World Neurosurg*. 2020;146:e811–e816.
- Mayorga EP, Bekerman JG, Palis AG. Webinar software: a tool for developing more effective lectures (online or in-person). *Middle East Afr J Ophthalmol*. 2014;21:123–127.
- Wilson M, Gerber LE. How generational theory can improve teaching: strategies for working with millennials? *Curr Teach Learn*. 2008;1:29–44.
- Mangold K. Educating a new generation: teaching baby boomer faculty about millennial students. *Nurse Educ*. 2007;32:21–23.
- Odedra D, Chahal BS, Patlas MN. Impact of COVID-19 on Canadian radiology residency training programs. *Can Assoc Radiol J*. 2020;71:482–489.