



COVID-19 Restrictions Presented Opportunities and Challenges for Plastic Surgery Residents

Les restrictions imposées par la COVID-19: des sources de possibilités et de difficultés pour les résidents en chirurgie plastique

Maya Zaidman, BSc¹, Sultan Al-Shaqsi, MBChB, PhD¹,
Celine Yeung, MD, MSc¹, Christine B. Novak, PhD^{1,2},
and Jana Dengler, MD, MASc^{1,3} 

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Abstract

Background: Restrictions placed during the COVID-19 pandemic to prevent viral spread led to substantial changes in surgical resident education. The aim of this study was to assess the positive and negative impact of COVID-19 on plastic surgery education and training and provide recommendations for continued competency. **Methods:** A cross-sectional online survey of plastic surgery residents across Canada was used to evaluate the impact of COVID-19 on clinical exposure, experience with virtual education, and long-term impact of COVID-19 on surgical training. **Results:** This study included 61 plastic surgery residents (40% participation rate). Common educational modalities used during COVID-19 included online seminars (95%) and workshops (58%). Teaching sessions were effective if structured around patient cases (72%), recorded (66%), and limited to 1 hour (64%). There were mixed reactions towards online education sessions; residents reported feeling grateful (54%), motivated (38%), enthusiastic (28%), overwhelmed (41%), pressured to participate (23%), and anxious (13%). There were significantly less residents who felt that their clinical exposure was sufficient during (21%) versus before (72%) pandemic restrictions ($P < .001$). Overall, 87% of residents felt that the pandemic had a negative impact on their training, surgical skill development, fellowship plans, and job prospects. **Conclusions:** During the initial wave of COVID-19, residents faced altered educational opportunities, which elicited positive and negative emotions with concern regarding surgical skill development and impact on future career plans. Characterizing early educational impact on residency training to identify opportunities for change is worthwhile as the overall effect of the pandemic is ongoing and remains uncertain.

Résumé

Historique : Les restrictions imposées pendant la pandémie de COVID-19 pour en éviter la propagation virale ont entraîné des changements importants dans la formation des résidents en chirurgie. La présente étude visait à évaluer les répercussions positives et négatives de la COVID-19 sur l'enseignement et la formation en chirurgie plastique et à formuler des recommandations sur le maintien des compétences. **Méthodologie :** Les chercheurs ont utilisé un sondage transversal en ligne auprès des résidents en chirurgie plastique du Canada pour évaluer les répercussions de la COVID-19 sur l'exposition clinique, l'expérience de l'enseignement virtuel et les conséquences à long terme de la COVID-19 pour la formation en chirurgie. **Résultats :** La présente

¹ Division of Plastic and Reconstructive Surgery, University of Toronto, Toronto, Ontario, Canada

² Division of Plastic and Reconstructive Surgery, Hospital for Sick Children, University of Toronto, Toronto, Ontario, Canada

³ Division of Plastic and Reconstructive Surgery, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada

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Corresponding Author:

Jana Dengler, Division of Plastic and Reconstructive Surgery, Sunnybrook Health Sciences Centre, University of Toronto, M1-500, 2075 Bayview Avenue, Toronto, Ontario, Canada.

Email: jana.dengler@mail.utoronto.ca

étude incluait 61 résidents en chirurgie plastique (pour un taux de participation de 40%). Les modes d'enseignement couramment utilisés pendant la COVID-19 incluaient les séminaires en ligne (95%) et les ateliers (58%). Les séances d'enseignement étaient efficaces si elles étaient structurées autour de cas de patients (72%), enregistrées (66%) et se limitaient à une heure (64%). Les réactions étaient mitigées quant aux séances de formation en ligne. Les résidents ont déclaré se sentir reconnaissants (54%), motivés (38%), enthousiastes (28%), dépassés (41%), poussés à participer (23%) et anxieux (13%). Beaucoup moins de résidents avaient l'impression que leur exposition clinique avait été suffisante pendant les restrictions liées à la pandémie (21%) qu'auparavant (72%; $p < 0,001$). Dans l'ensemble, 87% des résidents trouvaient que la pandémie avait un effet négatif sur leur formation, l'acquisition de leurs compétences chirurgicales, leurs projets de surspécialité et leurs perspectives professionnelles.

Conclusions : Pendant la première vague de COVID-19, les résidents ont dû composer avec des modifications à leurs possibilités de formation, qui ont donné lieu à des émotions positives et négatives et à des inquiétudes quant à l'acquisition de leurs habiletés chirurgicales et aux répercussions sur leur plan de carrière. Il est intéressant de caractériser les répercussions précoces sur la formation en résidence pour déterminer les occasions de changement, car l'effet global de la pandémie se poursuit et demeure incertain.

Keywords

COVID-19, pandemics, surgical education, distance education, surgery, information technology, survey

Mots clés

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has had an immense impact on all aspects of the global health care system, including surgical education. Health care restrictions to prevent viral spread have had direct and indirect effects on traditional surgical training, including the postponement or cancellation of nonurgent surgical cases, adoption of a minimal staffing model, and conversion of in-person clinic visits to virtual telehealth. These restrictions have led to the transformation of the education model and resulted in reductions and changes in surgical exposure and training experiences for fellows, residents, and medical students.¹⁻⁵

to prevent the spread of COVID-19 and minimize the disruption to medical education, residency programs adapted their educational models, converting face-to-face teaching sessions to virtual platforms.⁶⁻¹⁰ New modes of educational delivery are variable and dependent on existing resources and the availability of new educational avenues. Strategies to adapt surgery residency education programs included daily briefing of home-based residents regarding clinical discussions about hospital-based activities, lab-based practice, integration of information technology, and national online teaching sessions.¹¹

With the uncertainty of the COVID-19 pandemic and the likely persistence of health precautions, traditional surgical education may continue to be replaced or supplemented with virtual teaching.^{5,12} To provide a realistic forecast of the potential long-term effects on surgical education, it is important to determine the positive and negative impacts of the COVID-19 pandemic on surgical training. By assessing the impact of COVID-19 on the education, clinical exposure, and personal well-being of plastic surgery residents, recommendations can be made to improve the medical and surgical education modalities of current and future residents.

The overall aim of this study was to assess the impact of COVID-19 on plastic surgery education and training. The specific aims were to assess the modalities of online education utilized by trainees, identify successful distanced learning strategies for surgical education, and evaluate perception of the long-term impact of COVID-19 on plastic surgery training.

Methods

This cross-sectional study utilized an online survey that examined the impact of COVID-19 on plastic surgery training in Canada during the 2020 academic year. The study was approved by our institutional review board and conducted in accordance with the principles of the Declaration of Helsinki.

The survey was designed to evaluate 4 domains: (1) demographic data including gender, age, and level of training, (2) perceived impact of COVID-19 on clinical exposure and activities, (3) participation in and experience with virtual education modalities during COVID-19, and (4) perception of the long-term impact of COVID-19 on plastic surgery training. The survey tool utilized a publicly available platform (Google Forms; Google Inc). Prior to distribution, the survey was pilot tested on 4 plastic surgery residents with different levels of training to ensure applicability and readability.

The final survey (Supplemental Appendix 1) was electronically distributed to all residents enrolled in a plastic surgery residency training program in Canada during the 2019/2020 academic year ($n = 152$ residents in 12 plastic surgery programs). An initial email invitation was sent in June 2020, with weekly reminder emails for 3 weeks.

All data were de-identified and transferred to a prepopulated Microsoft Excel sheet (Microsoft Corp). Statistical analyses were performed using Student *t* test or Wilcoxon-Mann-Whitney *U* test for continuous variables and χ^2 or Fisher exact test for categorical variables. Statistical analyses were

Table 1. Demographics of Study Participants.

| Variable | Frequency, n (%) |
|---------------------|------------------|
| Participants | 61 |
| Age | |
| 26-30 years | 30 (49) |
| 31-35 years | 27 (44) |
| 36-40 years | 4 (7) |
| Sex | |
| Male | 34 (56) |
| Female | 27 (44) |
| Postgraduate level | |
| PGY-1 | 8 (13) |
| PGY-2 | 7 (11) |
| PGY-3 | 9 (15) |
| PGY-4 | 11 (18) |
| PGY-5, PGY-6, PGY-7 | 26 (43) |

performed using GraphPad Prism version 5.0 for Windows (GraphPad Software).

Results

Study Participants

There were 61 plastic surgery residents (male: $n = 34$; female: $n = 27$) who participated in the study (40% participation rate). Nearly half of the residents were 30 years old or younger (49%), and all training levels were represented in the sample (Table 1).

Educational Resources

During the COVID pandemic, all residents participated in educational sessions (Table 2). The most common sessions were online resources: seminars ($n = 58$; 95%) and workshops ($n = 34$; 58%). The majority of residents engaged in self-directed learning ($n = 51$; 84%) and learned while being on-call ($n = 49$; 80%). The online teaching sessions were equally based locally ($n = 56$; 92%), nationally ($n = 54$; 88%), and internationally ($n = 56$; 92%). The most common online learning platform used during COVID was Zoom (Zoom Video Communications Inc, 2016). Descriptive statistics outlining the learning modalities, resources, and platforms are summarized in Table 2.

Residents reported that educational sessions were most useful if the presentations were structured around patient cases ($n = 44$; 72%), recorded ($n = 40$; 66%), and limited to 1 hour ($n = 39$; 64%; Figure 1). Additional commonly cited qualities of useful teaching sessions include holding the sessions during the daytime ($n = 35$; 57%) and providing opportunities for learners to ask questions ($n = 27$; 44%).

There were positive and negative reactions towards online education sessions (Figure 2). The majority of residents expressed gratitude for these learning opportunities ($n = 33$; 54%). Positive emotions experienced included feeling motivated ($n = 23$; 38%), enthusiastic ($n = 17$; 28%), and inspired ($n = 8$; 13%). Negative emotions experienced included feeling

Table 2. Educational Resources Used During COVID-19 Pandemic.

| Resource | Participants ($n = 61$), n (%) |
|---------------------------------------------------|-------------------------------------|
| Learning modalities | |
| Online seminars | 58 (95) |
| Self-directed reading | 51 (84) |
| ER and on-call procedures | 49 (80) |
| Main OR cases | 38 (62) |
| Online workshops | 34 (56) |
| In-person clinics | 28 (46) |
| Minor OR cases | 25 (41) |
| One-to-one online staff briefings and discussions | 10 (16) |
| Virtual clinics | 8 (13) |
| Online virtual operations | 3 (5) |
| Research projects | 1 (2) |
| Simulated cases | 1 (2) |
| Online rounds | 1 (2) |
| Learning resources | |
| Local residency program online teaching | 56 (92) |
| National online teaching | 54 (89) |
| International online teaching | 50 (82) |
| Society-specific webinars/lectures | 32 (52) |
| Regional/province-wide online teaching | 29 (48) |
| Private company webinars | 15 (25) |
| Online journals and textbooks | 1 (2) |
| Society- and industry-sponsored online teaching | |
| General plastic surgery-related (eg, ASPS) | 94 (42) |
| Hand surgery (eg, ASSH, AAHS, etc) | 57 (26) |
| Nonspecific (Stryker, Mentor) | 31 (14) |
| Craniofacial surgery (eg, AO CMF) | 26 (12) |
| Aesthetic surgery (eg, ASAPS) | 12 (5) |
| None | 2 (1) |
| Learning platform | |
| Zoom | 61 (100) |
| Microsoft Teams | 4 (7) |
| FaceTime | 4 (7) |
| WebEx | 2 (3) |
| WhatsApp | 1 (2) |
| Skype | 1 (2) |

Abbreviations: ER, emergency room; ASPS, American Society of Plastic Surgeons; ASSH, American Society for Surgery of the Hand; AAHS, American Association for Hand Surgery; AO, Arbeitsgemeinschaft für Osteosynthesefragen; CMF, Cranio-Maxillofacial; ASAPS, American Society for Aesthetic Plastic Surgery; OR, operating room.

overwhelmed ($n = 25$; 41%), pressured to participate ($n = 14$; 23%), anxiety ($n = 8$; 13%), and disappointment ($n = 2$; 3%).

Clinical Exposure and Impact of Pandemic Restrictions

There was a significant difference in the perception of clinical exposure before and during the COVID-19 pandemic ($P < .001$; Figure 3). There were significantly less residents who felt that their clinical exposure and training was sufficient during COVID-19 ($n = 13$; 21%) compared to before the COVID-19 restrictions ($n = 44$; 72%). Fifty-two percent of residents who felt that they had sufficient clinical exposure before COVID-19 ($n = 24/46$) no longer felt that they had adequate learning opportunities during the COVID-19 restrictions; 24% felt they

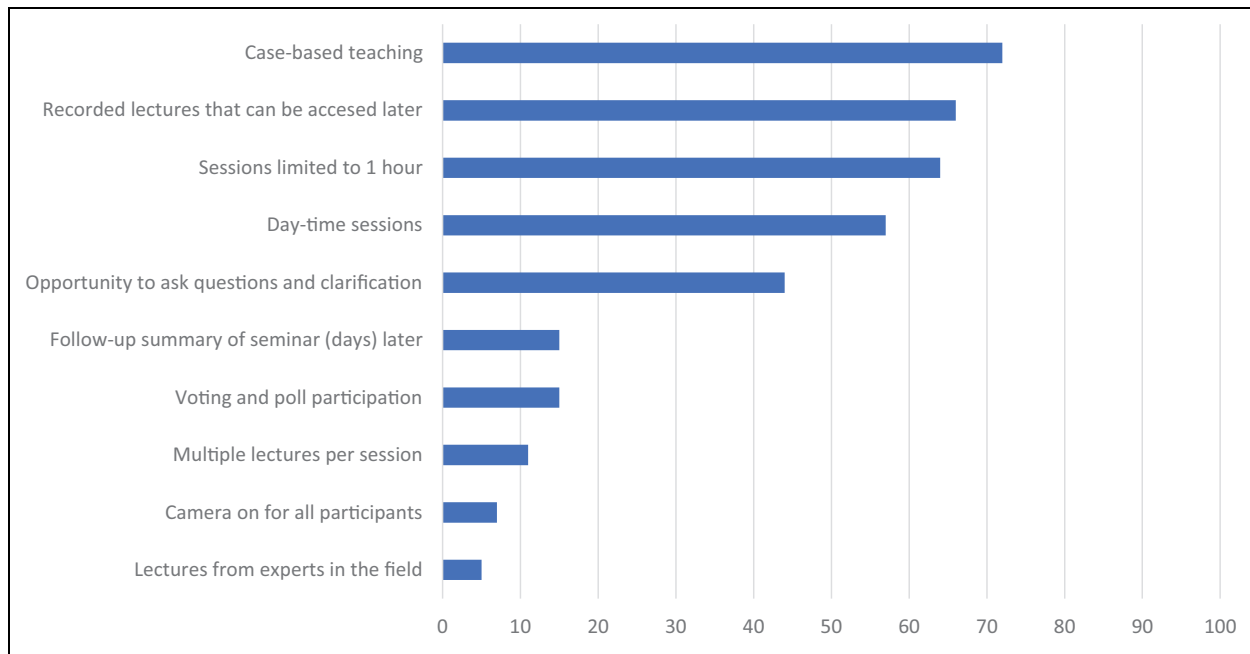


Figure 1. Qualities of online education sessions. The qualities that plastic surgery residents (n = 61) found helpful are shown as percentages.

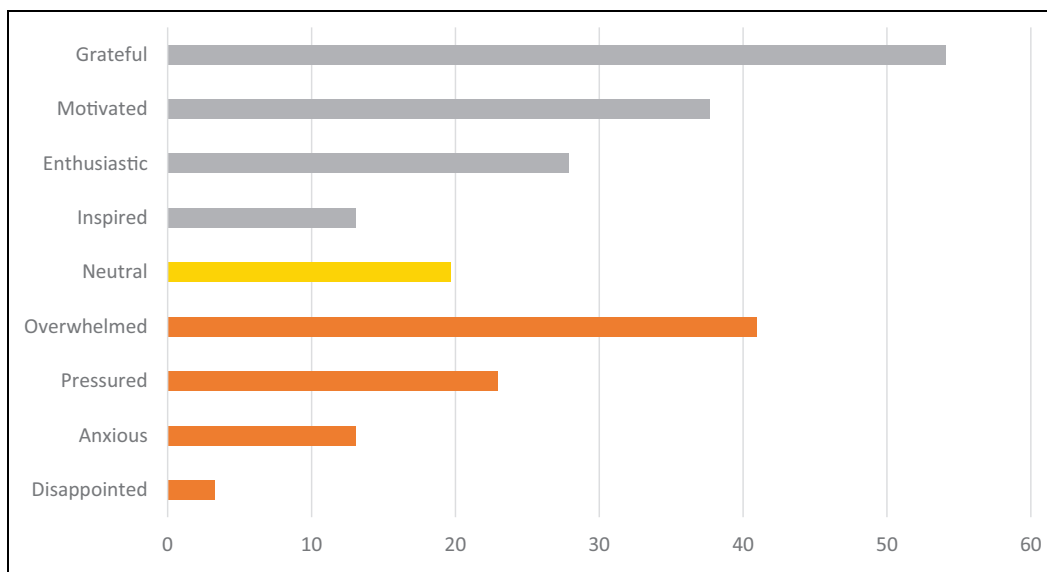


Figure 2. Assessment of emotions experienced related to online education sessions. Positive (shown in green), neutral (shown in yellow), and negative (shown in red) emotions experienced by plastic surgery residents (n = 61) towards online education sessions are shown as percentage.

continued to have adequate learning opportunities. Five percent (n = 3) of all residents felt that their exposure improved as a result of the pandemic.

Overall, 87% of residents reported that the pandemic negatively impacted their training (Figure 4), future job and practice plans (85%), future fellowship plans (85%), operative exposure and surgical skills (85%), clinic exposure (75%), and on-call (41%). In contrast, a positive impact on formal didactic educational opportunities was reported by the majority of residents (69%). Perception of educational impact differed between

junior and senior residents. Senior residents more frequently reported a negative impact of the COVID-19 pandemic on future fellowship plans (63% vs 7%, $P < .001$), job prospects (61% vs 7%, $P < .001$), and operative exposure and surgical skills (89% vs 73%, $P = .018$).

Discussion

The COVID-19 pandemic restrictions necessitated residency programs to adopt new measures to prevent viral spread. Our

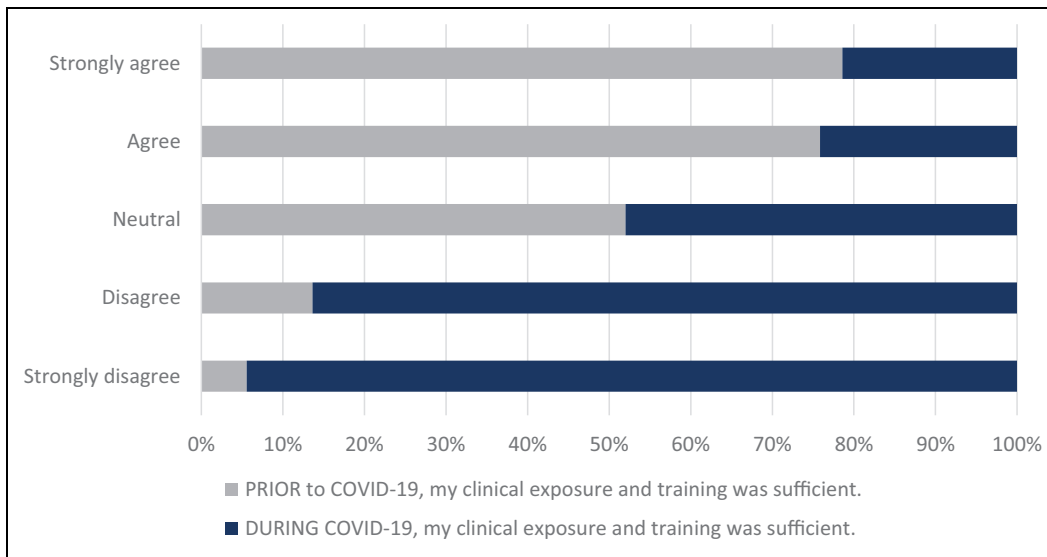


Figure 3. Assessment of clinical exposure and training with COVID restrictions. Clinical exposure reported by plastic surgery residents (n = 61) before (grey bars) and during (blue bars) COVID-19. There were significantly less residents who felt that their clinical exposure and training was sufficient during COVID-19 (P < .001).

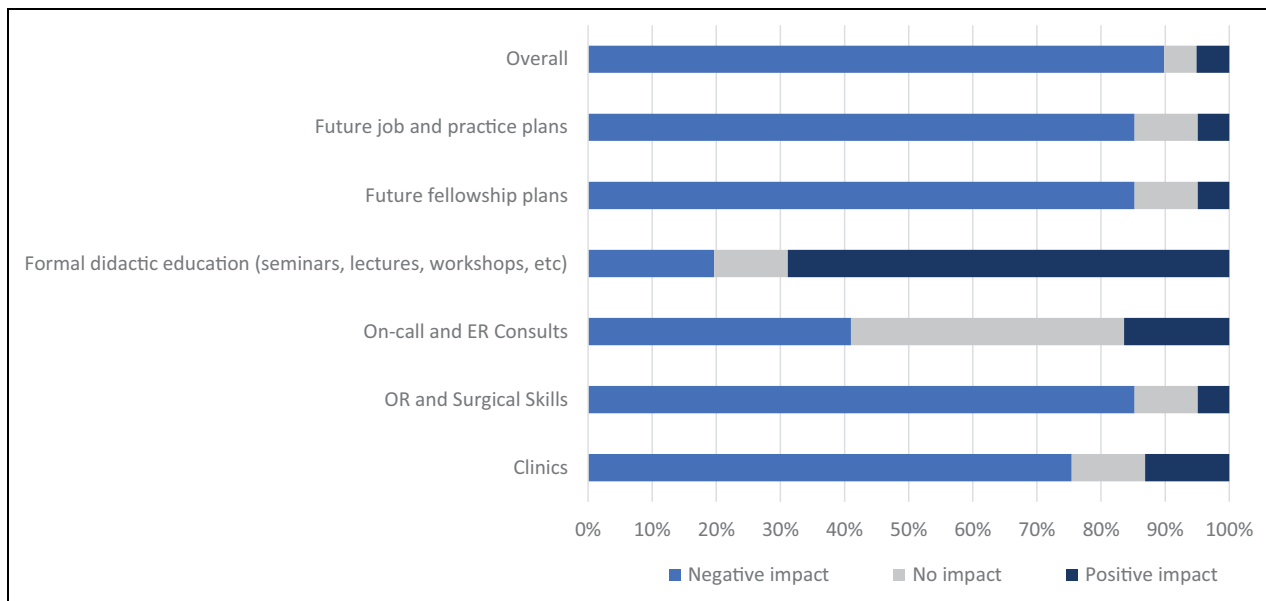


Figure 4. Assessment of the impact of COVID-19. Overall, the impact of COVID-19 was negative for all domains except education opportunities. ER indicates emergency room; OR, operating room.

study found that the restrictions on health care due to COVID-19 had negative and positive impacts on educational, clinical, and personal experiences. The decrease in face-to-face education sessions provided the opportunity for virtual educational sessions that were beneficial. However, the system-level restrictions on patient care had an overall negative impact on the volume of clinical and surgical experiences.

Many of the residency program changes required adaptation of traditional modalities of education from in-person to online formats.^{11,13,14} Online seminars were the most common educational modality that residents participated in and were seen as

beneficial. There were several qualities that residents found were useful for online educational sessions: case-based teaching, limiting the length of seminars to 1 hour, and recordings that would be available to review at a later time. Case-based teaching encourages critical thinking and enhances clinical knowledge.¹⁵ Limiting the length of educational sessions may relate to the decrease in audience retention with increased duration of video-based learning, which can overwhelm the working memory and inhibit learning.^{16,17} This finding may be further explained by the cognitive load theory, which assumes that human cognition has a limited capacity for taking in new

information and that each learning task has different types of cognitive load that must be optimized when presenting complex tasks.¹⁸ With the combination of managing both clinical duties and daytime online sessions, residents preferred online lectures to be recorded with the option to view the lecture later. Whether this archived resource is accessed or how often it is accessed are yet to be determined. Asynchronous online learning provides individuals with the freedom to have autonomy over their education and create their own schedules that can be optimized to meet individual learning needs.¹⁹ The flexibility of online education can also improve faculty turnout and permit remote access that is more amendable to clinical demands.¹⁴

While online sessions were perceived to be a beneficial education modality, some residents noted that virtual platforms lacked interaction and participation that was more easily facilitated through traditional face-to-face seminars. With online modalities, studying alone may lead to feelings of social isolation and may have detrimental effects on social and mental well-being.²⁰ During COVID-19, this may be compounded by the psychological effect caused by the uncertain outcome of the pandemic and limited therapeutic options.¹⁴

Although few residents felt that requiring the camera to be on for all participants was useful for online seminars, other features may be implemented to ameliorate the effects of decreased face-to-face interactions, such as self-test questions incorporated throughout a presentation and designated times for questions and discussion during online presentations. According to the theory of situated learning, the ability to engage in active participation and interaction will facilitate the learning process of residents on virtual platforms.²¹ Self-test questions can help learners identify gaps in knowledge, strengthen concepts that they may already understand, and provide them with the opportunity to ask questions. Using various teaching styles can help learners manipulate information in different ways such that complex information can be constructed into cognitive schemas and processed into a learners' long-term memory.¹⁸

This survey found that 84% of residents are motivated, self-directed learners who utilized self-directed study to maintain their education (eg, accessing geographically based online teaching, society-specific or private webinars, and textbooks or online journals). Self-directed study has been found to be at least as effective as traditional learning modalities and even superior to the didactic teaching of some topics in medicine²² and allows residents to learn using the method that best fits their learning style and focus on topics of interest.²² The variety of learning styles and topics permitted by self-directed study was evident through the different types of learning resources accessed by participating residents, including geographically based online teaching, society-specific or private webinars, and textbooks or online journals. Thus, self-directed study can be used as an effective supplementation to residency education.

Overall, our study found positive and negative impacts related to the COVID-19 restrictions. Generally, the impact of COVID-19 on didactic education was positive, which has also been shown in other studies.²³ This positive influence is

likely attributed to increased flexibility in scheduling, reduced commute time and costs to and from educational events, the continued delivery of an educational curriculum, and access to a range of experts facilitated by online sessions. However, a negative impact was found on the residents' clinical exposure. Prior to COVID-19, most residents agreed that their clinical exposure and training was sufficient, which changed with the implementation of COVID-19 restrictions. With the cancellation of many procedures and reductions in the surgical team size to meet public health guidelines, the clinical opportunities of many residents diminished during the pandemic. This negative effect on resident surgical training experience has been reported in other disciplines as well.^{14,23,24} However, this pattern was not universally reported by all residents in our study, with some residents reporting no change in quantity of operating room (OR) exposure but instead a shift towards cancer and trauma cases. One resident indicated an increase in clinical exposure due to often being the only resident present. This positive experience may be related to program size as residents enrolled in larger residency programs report less operative experience compared to those in smaller programs.²⁵ With fewer residents present in clinics due to pandemic restrictions, those in larger programs may have had more clinical opportunities compared to before the pandemic when cases were distributed among a greater number of residents.

While most residents agreed that their clinical exposure during COVID-19 was not sufficient, emergency and on-call procedures, main OR cases, in-person clinics, and minor OR cases were still ongoing. With the transition towards a competency-based education model, the negative impact of COVID-19 on OR and surgical skills may pose a concern for surgical residents and residency programs.²⁶ The shift from the emphasis on training duration to the achievement of objective milestones and competency requires experience with surgical cases and clinical volumes in resident training. In the more senior stages of training, these concerns may become more prevalent due to the time limitation prior to graduation. Previous studies have reported that higher surgical volumes are associated with better outcomes in a variety of procedures.^{27,28}

It is imperative for surgical training programs to provide alternative ways of obtaining clinical experiences. In-person simulation with box trainers or cadaver models has traditionally been used to supplement operative exposure but has been challenging to implement during COVID-19 due to social distancing measures and shortages of personal protective equipment.¹⁴ Increasing access to simulated models (eg, high-fidelity microsurgery models, virtual reality training, web-based task trainers, etc) or high-quality surgical skills videos based on cognitive task analysis principles^{29,30} could help with increasing operative or clinical exposure and provide opportunities for assessment and feedback in the future.^{31,32} Additionally, it is important for surgeon educators to be mindful that residents may be redeployed or their schedule may be drastically changed as a result of changing policies on their clinical responsibilities. As such, having access to these models after hours, or during times that are more conducive to a

resident's schedule, should be emphasized. Alternate learning activities were also proposed by Tuma et al,³³ which include writing clinical questions, recording and reviewing surgical skills with preceptors, and developing online surgical education platforms like the Surgical Council on Resident Education (SCORE) portal. While these strategies may require a longer upfront investment by surgeon educators, developing these tools could serve to benefit all resident learners at all levels, even on the global scale.

Senior residents understandably had more concerns regarding future fellowship and job plans compared to junior residents. Residents commonly pursue further fellowship training in another country, and it may take time to arrange observerships and electives at other institutions. Travel restrictions may have circumvented these plans, limited or prevented trainees from attending in-person fellowship or job interviews, and ultimately caused increased anxiety around future career plans.

There were both negative and positive emotions experienced by residents during the COVID-19 pandemic. The overarching emotion felt by participants regarding online education sessions was gratitude. With the unprecedented nature of the pandemic and the uncertainty on the impact on training, residents were grateful for the continuation of their education. Similarly, many residents felt motivated by the online education sessions. This may be attributed to reassurance of the continuation of educational programming, a heightened desire to help during a public health crisis, or the increased public admiration for medical professionals at this time. In contrast, a high number of residents also felt overwhelmed by online educational sessions, which may be related to the substantial changes in their educational program and the difficulty involved in navigating large-scale transitions and unmet expectations. Concerns around resident psychological health during COVID-19 have been raised in various studies.^{14,23} Strategies that have been used to decrease the negative impact of the pandemic on resident mental health include daily mindfulness pauses, ensuring access to mental health professionals, weekly check-ins with the program director, peer support, and providing resources for stress management.¹⁴

Limitations of this study include restriction to one surgical specialty and the moderate response rate. Studies with low response rates may limit the generalization of the results due to potential response bias. However, surgical residents are a relatively homogeneous cohort, which may decrease the associated bias from a limited sample.³⁴ Our study included only plastic surgery residents, and the responses and perceptions may not be similar in other surgical specialties. However, due to the similar global pandemic educational and clinical restrictions for all surgical specialties and heterogeneous samples, it is likely that our study results may be applied to trainees in other specialties and countries. As this survey was sent to residents over 3 weeks in June 2020, the results reflect the first 3 months of pandemic-related changes to surgical education and training. Further research is required to assess the long-term impact of online education formats and decreased clinical volume on resident training and psychological well-being. As this

study was performed at the beginning of the pandemic restrictions, it may not reflect the true differences in case logs that occurred with prolonged clinical restrictions. Future studies should be performed to assess and compare the impact of COVID-19 restrictions on the standard case volumes and differences in junior and senior residents. The perceptions and feelings reported by residents may have been also impacted by personal circumstances caused by the pandemic, including social isolation, concern for family members, and changes in lifestyle.

While the COVID-19 pandemic has negatively impacted certain aspects of surgical training and mental well-being, some strategies implemented during the pandemic may positively affect future training if applied long term. Online seminars can be used as a supplement to traditional didactic education to increase the flexibility and autonomy within resident training. Increased access to simulated models and high-quality surgical skills videos can be used to supplement clinical exposure. Effort directed at developing online surgical education platforms will also help to curtail decreased clinical exposure. Finally, mental health strategies used to mitigate negative emotions caused by the pandemic, such as weekly check-ins and access to mental health professionals, should be maintained to address any lasting effects of the pandemic on resident well-being as well as future stressors.

Surgical residents were faced with altered educational opportunities during COVID-19, which elicited mixed emotions and an overwhelming concern on surgical skill development and potential impact on future career plans. The long-term impact of COVID-19 on resident education remains to be seen. Residents anticipate that increased online education will be incorporated into residency training in the long term. Continued commitment to assessment of the educational impact of COVID-19 on residency training to identify opportunities for change is worthwhile, as the overall effect of the pandemic is ongoing and remains uncertain.

Authors' Note

This project was approved by the Sunnybrook Research Ethics Board at Sunnybrook Health Sciences Centre, REB protocol #2174. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5). Informed consent was obtained from all patients for being included in the study.


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ORCID iD

Jana Dengler, MD, MASC  <https://orcid.org/0000-0002-4717-5305>

Supplemental Material

Supplemental material for this article is available online.

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