

# A Hand Call Curriculum for Plastic Surgery Residents

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**Background:** The ability to diagnose and manage patients with acute hand injuries is an essential component of plastic surgery residency. This study proposes an innovative and feasible curriculum to improve hand surgery education for plastic surgery residents and ensure optimal care for patients with hand injuries.

**Methods:** A hand call curriculum for plastic surgery residents (n = 29) from two institutions was implemented from 2018 to 2020. In 2018 and 2019, a hand call boot camp was conducted, while additional curricular sessions for anatomy and didactic learning were added in 2019–2020. Pre and post test assessments, as well as confidence assessments were conducted in 2018 and 2019.

**Results:** In 2019, after having completed the boot camp, residents indicated significantly more confidence in identifying hand emergencies and formulating a basic treatment plan, including when to enlist help ( $P = 0.0313$ ). Overall, residents in earlier years (PGY 1–3) demonstrated steeper changes in confidence and readiness to take hand call than those in more senior years (PGY 4–8). Knowledge test scores improved amongst residents in both PGY groups following boot camp in both 2018 and 2019.

**Conclusion:** Findings from our study will be used to optimize the hand call curriculum following limitations with COVID-19 and consider wider implementation across other plastic surgery programs nationally. (*Plast Reconstr Surg Glob Open* 2021;9:e3984; doi: 10.1097/GOX.0000000000003984; Published online 7 December 2021.)

## INTRODUCTION

Acute hand and upper extremity injuries account for over 4.7 million emergency department visits each year.<sup>1</sup> A reported three to four million working days each year are lost as a result of hand injuries.<sup>2</sup> Unfortunately, a poorly treated hand injury can have significant consequences and may result in permanent dysfunction.<sup>3</sup>

Providing trainees with fundamental skills to treat patients on call from the inception of their training is critical to safe and effective patient care. As many academic medical centers share hand call responsibilities between plastic and orthopedic departments, plastic surgery

residents are frequently responsible for the management of acute hand injuries and consultations on call.

Unfortunately, residents enter plastic surgery training programs with variable exposure to hand surgery, across both integrated and independent training tracks. Program-based hand surgery rotations and general curriculum often focus on elective hand surgery, leaving minimal preparatory education for acute hand conditions encountered on call. As a result, while plastic surgery residents are expected to diagnose and manage acute hand injuries on call, they may lack clinical skills, knowledge, and confidence to safely care for these patients.

Currently, no optimal curriculum exists to prepare plastic surgery residents to diagnose and manage acute hand injuries. Various surgical specialties employ short courses of intense preparatory “boot camp” training to improve the knowledge and readiness of their trainees to treat patients.<sup>4–8</sup> Within the specialty of plastic surgery, a two day boot camp designed to introduce general core plastic surgery concepts is offered to all new plastic surgery residents through the American Council of Academic Plastic Surgeons.<sup>9</sup> Although the topic of hand surgery is integrated into the American Council of Academic Plastic Surgeons boot camp, it does not provide in-depth education strategies for retained knowledge. Accordingly, the purpose of this study was to design and implement a curriculum that prepares plastic surgery residents to safely

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and effectively diagnose and manage acute adult and pediatric hand call consultations. We report the results of 2 successive years of boot camp implementation to demonstrate that improved resident knowledge and confidence in treating acute hand injuries may have an important impact for residents, faculty and plastic surgery programs on a national level.

## METHODS

Hand call boot camp was conducted at Nationwide Children's Hospital, a teaching affiliate of The Ohio State University (OSU) in Columbus, Ohio, for 2 successive years. IRB exemption was obtained. In July 2018 and August 2019, a single-day intensive hand call boot camp was conducted for plastic surgery residents. This training took place during resident protected educational time where they were exempt from clinical duties to focus on the learning experience. A large auditorium style conference room equipped for presentations and space for skills practice was utilized. Pre- and post-tests of knowledge and confidence were completed by residents immediately before and after the boot camp in both 2018 and 2019. In January 2020, an anatomy laboratory session utilizing cadaver models for hands on practice of common procedures encountered on hand call was conducted for NCH/OSU plastic surgery residents (n = 14).

### Participants

#### Trainees

Over the 2-year period, 29 plastic surgery residents in both integrated and independent positions participated in the boot camp. In 2018, 12 Ohio State University residents (PGY 1–8) took part, whereas in 2019, 17 residents (PGY 1–8) from two institutions (OSU and University of Cincinnati) participated. In 2018, the boot camp was offered to all OSU plastic surgery residents and to all OSU and University of Cincinnati residents in 2019. Starting in their PGY 2 year, plastic surgery residents have 2 months of nontrauma hand rotations and spend one month on a pediatric rotation where they are responsible for primary pediatric hand call. During this month, a back up senior resident is available; however, the PGY 2 resident is the primary point of contact for the care of hand call patients. From PGY 3 to PGY 6 (integrated) and PGY 6 to 8 (independent), each resident has 1–2 months of nontrauma hand surgery exposure per year. During these years, residents are responsible for hand call 3–6 months of the year between adult and pediatric rotations.

#### Faculty

Boot camp instructors included three attending faculty surgeons from the departments of plastic and orthopedic surgery with content expertise in hand surgery. Faculty members provided didactic lectures and case based scenarios for key topics encountered in acute hand injuries. In addition to faculty members, a cast technician assisted with education for the splinting and casting sessions. All faculty volunteered their time for the educational sessions.

## Takeaways

**Question:** How do we educate plastic surgery residents to competently manage hand trauma on call?

**Findings:** Knowledge and confidence of residents improved after a boot camp hand call curriculum.

**Meaning:** A hand call curriculum for plastic surgery residents is beneficial to prepare residents to safely manage common acute hand conditions.

### Curriculum Design and Implementation

The hand surgery curriculum was designed to focus on key topics encountered on adult and pediatric hand call, including the following:

1. Hand call basics, management of the pediatric hand patient
2. Hand anatomy, history & physical examination
3. Imaging – indications and interpretation, C-arm use
4. Fractures and dislocations (including splinting and casting)
5. Fingertip, nailbed, and soft-tissue injuries
6. Nerve and tendon injuries (flexor, extensor)
7. Compartment syndrome/IV infiltration injuries, infections, and bite injuries
8. Replantation/revascularization

Content was chosen based upon review of the literature and institutional experience with acute hand injuries. A modified Delphi approach to achieve consensus of the key topics by five fellowship trained hand surgeons was performed. Fifteen OSU plastic surgery residents were subsequently surveyed to determine the perceived importance of each topic. Topics deemed lower in importance were combined into the same session in the curriculum. Topics were limited to those encountered as acute hand consultations on call and did not include elective hand procedures or chronic conditions. As plastic surgery residents at our institution were not responsible for managing distal radius or forearm fractures, these topics were not included in the curriculum.

Survey feedback from the 2018 boot camp was solicited from participating residents and appropriate changes incorporated into the 2019 session. These included a greater focus on adult hand injuries and more time devoted to skills training for splinting and casting. Didactic lectures and interactive clinical case scenarios were designed to provide practical knowledge relevant to hand call. Feedback was provided throughout the sessions from faculty. The timeframe for the boot camp was chosen to effectively deliver the content and maintain the attention of the learners, while allowing them to complete non-urgent clinical duties before and after the session.

### Boot Camp Outline

- Pre-tests (knowledge & confidence) – 30 minutes
- Interactive didactic lectures on key topics – 1.5 hours
- Case based clinical scenarios on key topics – 45 minutes
- Casting/splinting session (instruction and practice) – 2 hours

The hand call curriculum was designed to take place in the early months (July or August) of the academic year as new residents enter the program and existing residents change PGY year and start new rotations. A clinical anatomy session for refreshing procedural hand call skills took place in early January 2020. Four attending hand surgeons served as instructors for the session, which reviewed relevant anatomy and provided instruction and feedback for residents in skills encountered on hand call. A follow up survey of the residents was conducted to determine the relevance of the anatomy session to hand call and elicit feedback for the future. A Plastic Surgery Foundation education grant (\$5000) was utilized for the cost of the cadaver laboratory and casting/splinting supplies in 2019. Costs of the education sessions were otherwise negligible.

A refresher skills hand boot camp was scheduled for the spring of 2020; however, due to restrictions with COVID-19, this session was converted to a virtual interactive case-based session using vignettes of common scenarios encountered on hand call. Residents had access to learning materials such as PSEN hand trauma modules to enhance their knowledge throughout the year.

#### Assessments

Knowledge and confidence in the diagnosis and management of hand injuries were assessed immediately before and after the boot camp in both 2018 and 2019. In 2018, the knowledge test was also repeated 3 months after the initial boot camp to determine retention of knowledge over time. A 10-question knowledge test was developed based on hand trauma literature and refined by five fellowship trained hand surgeons. In 2019, the test was expanded to 15 questions to include more adult hand trauma utilizing ASPS in-service practice questions (see Appendix 1). The confidence survey assessed perceived comfort with common tasks on call using a five-point Likert scale (1 “not at all confident” to 5 “very confident”) (see Appendix 2). Open-ended feedback regarding the

overall utility of the boot camp was solicited at the end of the survey. Resident demographics, including information about level of training and hand surgery experience, were collected.

## DATA ANALYSIS

#### Confidence Survey

Resident years were categorized into two groups: PGY years 1–3 and PGY years 4–8. Likert scale data were reported as median and interquartile ranges. Differences were assessed using Wilcoxon signed rank test for pre and post responses. Kruskal-Wallis test was used to compare differences between groups.

#### Knowledge Assessment

Mean differences were computed between pre and post scores, and paired *t* test was used to test for difference. Findings were determined to be significant at a *P* value less than 0.05. All statistical tests and figures were conducted and created on SAS Enterprise, version 8.1.

## RESULTS

A total of 29 plastic surgery residents in both integrated and independent positions from two institutions participated in the boot camp over the 2-year period. This cohort was broken down into 12 residents in 2018 and 17 residents in 2019. A total of 20 residents (*n* = 7 in 2018, *n* = 13 in 2019) completed the demographic and confidence surveys (Table 1), whereas all 29 residents completed the knowledge tests. In 2018, 57.14% (*n* = 4) of the residents were in PGY years 4–8, whereas in 2019, the 54.85% (*n* = 7) of residents were in PGY years 1–3. Residents were primarily on the integrated pathway for both years (85.71% in 2018 and 76.92% in 2019) with a majority reporting having had some hand call and hand rotation experience (71.43% in 2018 and 61.54% in 2019) (Table 1).

**Table 1. Description of Resident Participants from Demographic Surveys**

Variable	Characteristic	2018		2019		
		Total (N = 7)		Total (N = 13)		
		N	%	N	%	
PGY year	1–3	3	42.86	7	53.85	
	4–8	4	57.14	6	46.15	
Pathway	Integrated	6	85.71	10	76.92	
	Independent	1	14.29	3	23.08	
Hand call	Yes	5	71.43	8	61.54	
		Pediatric	4 / 5	80	0 / 5	0
		Adult, non-moonlighting	0 / 5	0	0 / 5	0
		Moonlighting	0 / 5	0	0 / 5	0
		Pediatric and adult	0 / 5	0	7 / 8	87.50
		Pediatric, adult, and moonlighting	1 / 5	1	1 / 8	12.50
		Pediatric and moonlighting	1 / 5	20	0 / 5	0
		No	2	28.57	5	38.46
		Yes	5	71.43	8	61.54
Hand rotation	<2 months	1 / 5	20	2 / 8	25.00	
	2–6 months	4 / 5	80	0 / 5	0	
	6–12 months	0 / 5	0	1 / 8	12.50	
	1–2 years	0 / 5	0	3 / 8	37.50	
	3–4 years	0 / 5	0	1 / 8	12.50	
	No	2	28.57	5	38.46	

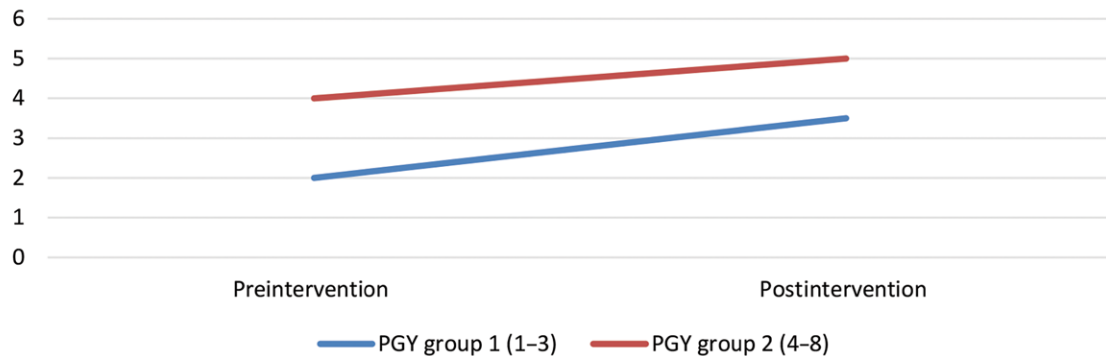
In 2019, after having completed the boot camp, residents indicated significantly more confidence in identifying hand emergencies and formulating a basic treatment plan, including when to enlist help ( $P = 0.0313$ ). Overall, residents in earlier years (PGY 1–3) demonstrated steeper changes in confidence and readiness to take hand call than those in more senior years (PGY 4–8) (Fig. 1). Although findings were not significant, confidence scores post boot camp increased compared with pre boot camp for both 2018 and 2019, with residents reporting median scores of 4 and 5 in readiness to perform an initial evaluation and work up, identifying hand emergencies and enlisting help, accurately interpreting x-rays, and identifying hand injuries that require surgical interventions (Tables 2 and 3).

Collectively, plastic surgery residents indicated the goal of the boot camp was achieved ( $P = 0.6831$  in 2018,  $P = 0.2668$  in 2019). Additionally, residents indicated that boot camp should be attended before starting clinical duties ( $P = 0.6831$  in 2018,  $P = 0.1726$  in 2019) and the

timing of the boot camp was appropriate ( $P = 0.6831$  in 2018,  $P = 0.6713$  in 2019). Residents also indicated that the topics chosen for the boot camp were appropriate in both years ( $P = 0.8231$  in 2018,  $P = 0.5726$  in 2019) and that teaching strategies were helpful ( $P = 0.8231$  in 2018 and  $0.6576$  in 2019). Similar agreement was noted in all categories when examined between integrated versus independent pathways, presence of hand call experiences, and presence of hand rotation experience.

Among the seven residents in 2018 and 13 residents in 2019, post boot camp readiness survey scores were available for six residents in 2018 and 13 residents in 2019. Collectively, residents demonstrated significantly higher readiness to take hand call following boot camp completion, with the median score increasing from 3.5 to 4 ( $P = 0.0313$ ) in 2018 and from 3 to 4 ( $P = 0.0078$ ). PGY 4–8 residents demonstrated higher levels of readiness in both years although pre/post change in readiness for 2019 appears to be steeper for PGY 1–3 residents in 2019 (Fig. 2).

2018 pre- and postintervention data comparing PGY groups on confidence to identify hand emergencies and formulate a basic treatment plan, including when to enlist help



2019 pre- and postintervention data comparing PGY groups on confidence to identify hand emergencies and formulate a basic treatment plan, including when to enlist help

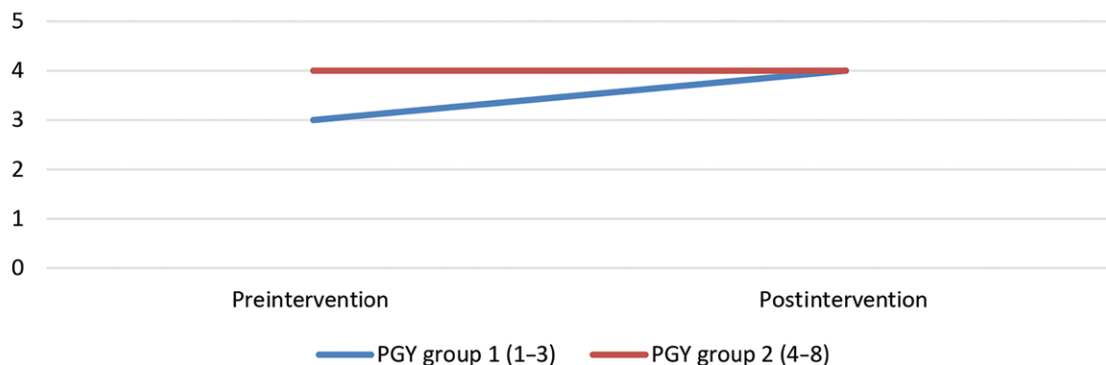


Fig. 1. Pre and post-test scores assessing resident confidence to identify hand emergencies and formulate a basic treatment plan, including when to enlist help.

**Table 2. Comparison of Pre- and Postconfidence Scores for Hand Boot Camp for 2018**

	Preintervention				Postintervention				P
	Min	Max	Median	Q1, Q3	Min	Max	Median	Q1, Q3	
Perform an initial evaluation and work up of the hand injury patient	1	4	4	3, 4	3	5	4	4, 5	0.1250
Identify hand emergencies and formulate a basic treatment plan, including when to enlist help	1	4	4	3, 4	3	5	5	4, 5	0.0625
Accurately interpret x-ray findings of common hand injuries	1	4	3	3, 3	2	5	4	4, 4	0.0625
Identify common hand injuries that frequently require surgical intervention	1	4	4	3, 4	3	5	5	4, 5	0.0625
Perform common ED procedures independently	1	4	4	3, 4	1	5	5	4, 5	0.1250

**Table 3. Comparison of Pre- and Postconfidence Scores for Hand Boot Camp in 2019**

	Preintervention				Postintervention				P
	Min	Max	Median	Q1, Q3	Min	Max	Median	Q1, Q3	
Perform an initial evaluation and work up of the hand injury patient	2	5	4	3, 4	2	5	4	4, 4	0.1484
Identify hand emergencies and formulate a basic treatment plan, including when to enlist help	2	5	4	3, 4	3	5	4	4, 5	<b>0.0313</b>
Accurately interpret x-ray findings of common hand injuries	1	5	4	2, 4	3	5	4	3, 4	0.1133
Identify common hand injuries that frequently require surgical intervention	1	5	4	3, 4	3	5	4	4, 4	0.2813
Perform common ED procedures independently	1	5	4	2, 4	1	5	3	3, 4	0.6172

Knowledge test scores improved amongst residents in both PGY groups following boot camp in both 2018 and 2019. Mean difference in test scores in 2018 was 2.0 (95% CI: -4.08, 0.08,  $P = 0.058$ ) while mean difference in test scores of 1.81 was significant in 2019 (95% CI: -3.37, -0.16,  $P = 0.0338$ ). In addition, in 2018 when the knowledge test was administered ( $n = 13$  residents) 3 months after the initial boot camp, a median score of 8 out of 10 was maintained. PGY 4-8 residents exhibited higher knowledge scores compared with PGY years 1-3, although statistical tests to compare both PGY groups were limited by small sample size (Fig. 3).

An estimated 71% (10/14) plastic surgery residents responded to a feedback and satisfaction survey following the anatomy cadaver laboratory. All residents indicated the laboratory was somewhat beneficial, with 40% indicating it was extremely beneficial. In total, 80% of the residents indicated it would be extremely valuable to hold cadaver anatomy sessions regularly with open-ended response comments, suggesting that a more formalized hand anatomy curriculum with an opportunity to practice skills was highly desired.

## DISCUSSION

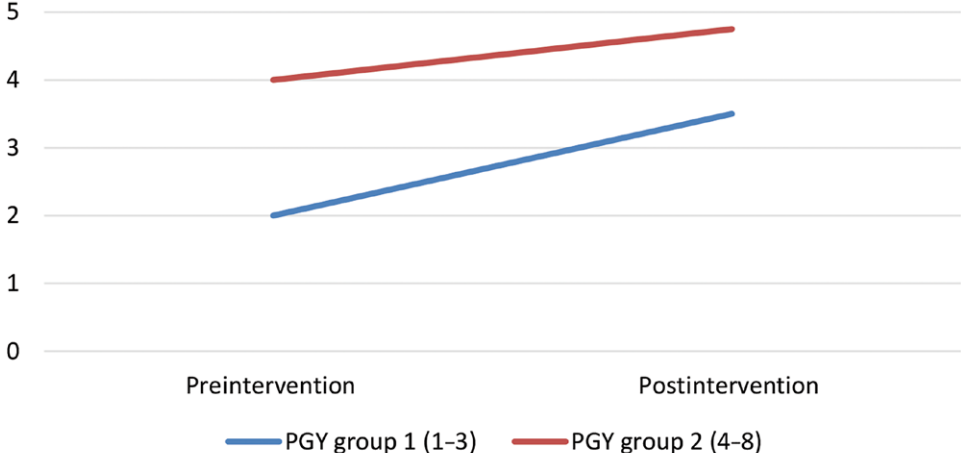
Boot camps across surgical sub-specialties have successfully demonstrated trainee acquisition of skills, knowledge and professionalism without risk to patients.<sup>4-8</sup> Over the past decade, there has been a decline in the number of hand surgeons taking call across the country, subsequently increasing the demand for hand trauma coverage at academic centers.<sup>10,11</sup> With many academic centers dividing call responsibilities between plastic and orthopedic surgeons, plastic surgery residents are routinely expected to care for patients with complex hand injuries in the acute setting. Accordingly, we aimed to fulfill an unmet educational need that would provide our plastic surgery residents with the knowledge and confidence required to

safely diagnose and manage patients with hand injuries on call. We implemented and examined the effectiveness of a boot camp that focused on case based learning and skills practice for acute hand call injuries. The overall cost and time commitment from residents and faculty was low, with the majority of cost being the anatomy cadaver laboratory adjunct learning session. Our pre and post-tests provided evidence that the hand call boot camp held early in the academic year improved both knowledge and confidence of plastic surgery residents in treating patients with hand injuries. Our boot camp in 2019 was expanded to include a second institution, demonstrating the feasibility of implementation across other plastic surgery residency programs. Findings from our experience will be used to optimize and expand the curriculum, as well as consider implementation across programs nationally.

Given that our residents are both integrated and independent and had variable exposure to hand surgery rotations, we felt it was important to include all PGY years in the boot camps. However, as many senior residents demonstrated higher baseline knowledge and confidence and indicated less subjective value in open-ended feedback, focusing the boot camp toward early years of training may be valuable in the future. As independent residents traditionally have minimal exposure and experience with hand surgery in their general surgery training, it may be beneficial for independent residents to attend the boot camp for all 3 years of training to maximize their education. Competency-based assessment of skills and knowledge in acute hand trauma could provide an objective measure to determine which residents would benefit most from the hand boot camp.

Ongoing resident education throughout the academic year is important to maintain knowledge and skills gained from the boot camp. In the 2019-2020 academic year, we initiated a curriculum including self-study, clinical anatomy laboratory dedicated to procedural hand call

### 2018 pre- and postintervention data on readiness to take on hand calls



### 2019 pre- and postintervention data on readiness to take on hand calls

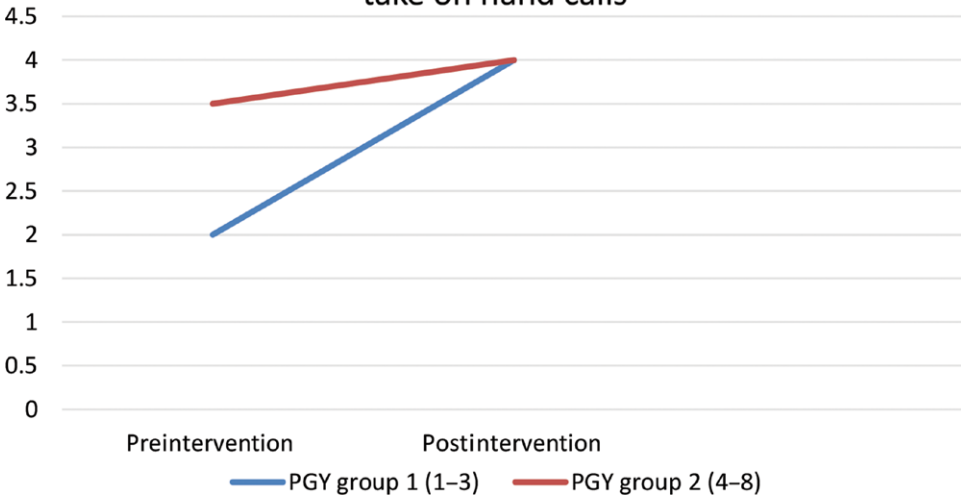


Fig. 2. Resident readiness to take hand call.

### Hand call boot camp knowledge scores for 2018 and 2019

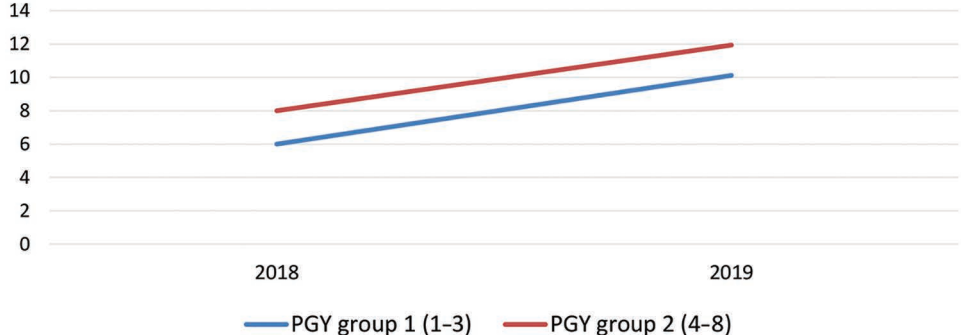


Fig. 3. Hand call boot camp knowledge scores for 2018 and 2019.

skills and planned for a skills refresher course and skills assessment with standardized patients. Unfortunately due to COVID-19, we conducted the refresher didactic session online in the spring of 2020 and were unable to assess the residents at that time. We plan to continue to hone the hand call curriculum to maximize resident education and retention in the future. Considerations include potential recording of applicable components of the curriculum for completion asynchronously, allowing hands on sessions to focus on deliberate practice and assessment.

Although our analyses examined collective changes in the knowledge and confidence of the group, due to limitations of the study design and effort to maximize resident confidentiality, individual pre/post improvements were not examined. Secondary to these limitations, we were unable to determine relationships between PGY year, residency pathway (integrated versus independent), previous hand call or hand rotation experience and boot camp impact. We recognize that exposure to hand call/didactics outside of the boot camp curriculum would also affect resident knowledge and confidence and may be a potential limitation of the study. As a power analysis was not performed before data collection, our findings on variables that were not significant currently may have potentially been significant had a larger sample size been available. However, the fact that differences in pre and post scores were found to be significant in more than one outcome does suggest a sufficient sample size to detect a difference.

Although this study has demonstrated the utility of focused hand call education in plastic surgery resident knowledge and confidence, it is still unclear when a resident is competent to take hand call independently and what training is required to achieve that level of competence. Accordingly, future directions include determination of the factors that influence readiness of a resident to take hand call without direct supervision, as well as development and assessment of entrustable professional activities specific to acute hand trauma. Assessment of patient satisfaction and outcomes to ensure a safe standard of care for acute hand injuries is essential going forward.

## CONCLUSIONS

The opportunity for trainees to hone clinical skills without causing harm to patients is critical. Currently, clinical exposure and education for plastic surgery residents in the diagnosis and management of acute hand

injuries is extremely variable, meaning residents may be inadequately prepared to manage consultations commonly encountered on adult and pediatric hand call. This study proposes an innovative and feasible curriculum to improve hand surgery education for plastic surgery residents and ensure the best care for patients with hand injuries.

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