



Surgical autonomy: A resident perspective and the balance of teacher development with operative independence

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ABSTRACT

Background: This study aims to understand the perspectives of operative autonomy of surgical residents at various postgraduate levels.

Methods: Categorical general surgery residents at a single academic residency were invited to participate in focus groups to discuss their opinions and definitions of operative autonomy. Employing constructivist thematic analysis, focus groups were audio recorded, transcribed, and inductively analyzed using a constant comparative technique.

Results: Twenty clinical surgical residents participated in 6 focus groups. Overarching themes identified include autonomy as a dynamic, progressive path to operative independence and the complex interaction of resident-as-teacher development and operative autonomy. Four within operative case themes were intrinsic factors, extrinsic factors, autonomy promoting or inhibiting behaviors, and the relationship between residents and attendings.

Conclusion: Residents define operative autonomy as a progressive and dynamic pathway to operative independence. Teacher development is viewed as both an extension beyond operative independence and potentially in conflict with their colleagues' development.

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Introduction

Over the past several years, there is growing concern that general surgery residents are not qualified to enter independent practice at the end of residency training.¹ Residents and surgical educators alike are faced with several challenges, such as work hour restrictions, patient safety, and malpractice and litigation concerns, that affect the goal of achieving operative competence and independence. In order to reach independence, residents must be granted progressive, supervised autonomy.

A well-known model for assessment of resident intraoperative autonomy is the Zwisch Score.² Developed from physician personal experience, autonomy was measured as the inverse of the level of help or guidance a resident received. The four levels of operative guidance have since been modified to: "Show and Tell", "Active

Help", "Passive Help", and "Supervision Only".^{3,4} This model has since been shown to have validity evidence as a measure of faculty guidance, and with the assistance of a smartphone-based application, resident autonomy can be assessed in real time and feasibly integrated into surgical training programs.⁵

With this ability to assess resident intraoperative autonomy, prior studies have emphasized that there is discordance between resident autonomy expectations and autonomy achieved, creating an autonomy gap.^{6,7} Similar disparities are also seen between residents and attendings with regards to opinions of learning needs in the OR.⁸ In order to narrow this gap, surgical educators must describe autonomy expectations from the perspectives of the surgical resident and the attending to facilitate a mutual understanding. Descriptions and measurement of autonomy, such as with the Zwisch Score, have been developed primarily from the attending surgeon perspective; therefore, the goal of the present study was to elicit the opinion from the resident perspective. We chose to approach this problem by adopting a constructivist paradigm, allowing for varying definitions of autonomy at different

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postgraduate levels. Constructivism allows for multiple, diverse interpretations of reality without requiring the acceptance of an ultimate truth or correct way of knowing.⁹ If definitions of autonomy vary across groups, we can further investigate the factors that influence autonomy at each postgraduate level and how autonomy might evolve over the course of a resident's training. We hope that by better understanding how residents define autonomy, we can identify areas of discordance between resident and attending opinions with a goal of achieving greater resident autonomy.

Material and methods

Participation and recruitment

During the 2018–2019 academic year, 44 clinical categorical general surgery residents at a single academic program were eligible to participate in the current study. Active clinical residents were recruited via email and focused group interviews were completed from March 2019–June 2019. Residents were divided into three levels of training: interns (PGY1), mid-level residents (PGY2–3), and senior residents (PGY4–5). Focus groups consisted only of residents within their level of training. Compensation for participation consisted of dinner from a local restaurant and a \$20 gift card. This study protocol was reviewed and approved by the Partners Institutional Review Board (Protocol#: 2018P002176).

Data collection

A semi-structured interview guide was developed by three members of the research team: a surgical resident (D.C.), a surgical attending with expertise in surgical education (M.K.), and an educational psychologist (E.P.). This guide consisted of open-ended questions regarding the resident's opinions of operative (Appendix A). The interview guide was piloted in two individual semi-structured interviews and a single focus group conducted with research residents who had previously completed their PGY3 year and had no active clinical responsibilities. The interview guide was refined based on preliminary discussions amongst the researchers following analysis of these transcripts.

All study groups were conducted in-person by a surgical resident member of the research team with formal training in qualitative research methods including semi-structured interviewing (D.C.). Before the interview, research participants were informed of the purpose of the study and that their recorded responses would remain confidential. Following a process of verbal consent, each focus group proceeded through the semi-structured interview guide designed to solicit resident perspectives on operative autonomy. The focus groups were audio recorded using a digital voice recorder and transcribed verbatim using institutional IRB-approved online software (www.transcribeme.com, TranscribeMe Inc.) prior to being reviewed by a team member and deidentified. An independent observer (J.O.) recorded field notes which were reviewed following each focus group and prior to analysis. Interview transcripts served as the primary data for analysis.

Data analysis

Interview transcripts were analyzed using an iterative, inductive approach to establish primary and secondary codes. Transcripts were initially openly coded by a single author (D.C.) using NVivo Software to label each discrete idea/concept. Primary codes were then consolidated into secondary and tertiary codes by the primary author (D.C.) and then reviewed by the research team (D.C., S.M., E.P., M.K.). All transcripts were reviewed by the research team who met multiple times to iteratively refine the codes until a consensus

codebook was established prior to complete, independent coding. Two independent coders, one male and one female (D.C., S.M.), then used a constant comparative method to refine the consensus codebook and establish consistency by testing on the preliminary research resident focus group. After finalizing and refining the codebook, the two coders independently coded all six clinical resident focus groups, and interrater alignment was established through discussion and review of codes after independent coding.

Constructive thematic analysis

In a second phase of analysis, codes were then grouped into broader themes, with a definition of each theme generated based on its associated codes. The two primary coders (D.C. and S.M.) processed these themes via an iterative process involving collapsing and expanding of themes and subthemes to ensure thematic categories accurately represented the transcribed data. This resulted in a themebook that was iteratively reviewed by the multidisciplinary research team (D.C., S.M., J.O., J.M., R.P., E.P., and M.K.). A member-checking step was conducted where the initial pilot study research residents reviewed the themebook and verified alignment of codes and themes. After this step, we accepted that our thematic framework accurately depicted the views of operative autonomy of residents at our institution and that as such, saturation had been reached.

Results

Our surgical residency consisted of 62 general surgery categorical residents including 44 active clinical residents and 18 residents currently conducting full-time research during the 2018–2019 academic year. Of the 44 active clinical residents, 20 (45.5%) participated in focus groups. Participant demographics included 7 PGY1 residents, 2 PGY2 residents, 5 PGY3 residents, 4 PGY4 residents, and 3 PGY5 residents. There was no statistically significant difference in gender representation across the three focus group populations.

The final codebook consisted of 23 unique codes, all of which appeared in at least one focus group at each postgraduate level, suggestive of thematic saturation. We collapsed these codes into 6 main themes (Table 1). Overarching themes include autonomy as a dynamic and progressive path to operative independence and the complex interaction of resident-as-teacher development and operative autonomy. Four within operative case themes were 1) intrinsic factors unique to residents and attendings, 2) extrinsic factors impacting residents and attendings, 3) autonomy promoting or inhibiting behaviors of residents and attendings, and 4) collaborative factors and the relationship between residents and attendings.

Theme 1: Autonomy is a progressive and dynamic process, throughout both residency training and within a case itself, with a goal of achieving operative independence

Most participants reported that the goal of operative autonomy is to obtain the skill set of a safe, independent-practicing general surgeon through progressive operative independence during residency. The goal of independent practice was also noted to extend beyond the operating room, including taking ownership of patients through the pre-operative (deciding on the need for an operation and consenting the patient) and post-operative process, including management of complications.

"The practical thing is, at the end of chief year you should be able to go into practice." (Senior Resident, Participant #21).

Table 1

Six main themes identified from the thematic analysis.

Theme 1: Autonomy is a progressive and dynamic process, throughout both residency training and within a case itself, with a goal of achieving operative independence.
Theme 2: Intrinsic factors unique to residents and attendings can augment or inhibit the autonomy within a case.
Theme 3: Behaviors exhibited by both residents and attendings can augment or inhibit autonomy when tenuous within a case.
Theme 4: Collaborative factors and the relationship between residents and attendings can augment the autonomy within a case.
Theme 5: Extrinsic factors and pressures on residents and attendings can hinder autonomy both within a case and throughout residency training.
Theme 6: Residents as teachers and resident teacher development can parallel autonomy but also come into conflict with its progression

More junior residents, particularly interns, described scaled down versions of independent decision making in level-appropriate cases, but also a focus on developing the prerequisite operative skills in order to demonstrate skill competency prior to being given the opportunity to make independent decisions. Participants at all levels believed that if basic operative skills could not be demonstrated, then independence should not be granted.

“...so that’s half of autonomy, just getting the ability to do the technical thing. And then the other half of autonomy in my mind is being given the opportunity to lead the operation.” (Intern, Participant #12).

Mid-level and senior residents characterize autonomy as independent decision making with variable levels of attending supervision. Participants described the ideal level of supervision as progressively declining over the course training, while independent decision making remained constant throughout. Residents believed that they should progress from supervised decision making with an attending scrubbed and present to more distant supervision to mirror that of future independent practice.

“The ability to make independent operative decisions within a case. So, moving from one step to another without somebody telling you where to go and without somebody directing you.” (Senior Resident, Participant #22).

Almost all residents described autonomy as dynamic with an ability to fluctuate both within a case and over the course of residency. This also included segmenting autonomy within a case; functioning more autonomously for one portion of a case but less so for another portion. This was described as a strategy that can be utilized to promote resident autonomy especially when time constraints are present, in order to maximize autonomy for key portions of a case. Residents happily describe a compromise or willingness to give up autonomy during a portion of a case they believe they are competent in, in order to gain autonomy in a portion of the case they believe they need to work on.

“Operative autonomy is when breaking down a case into those kinds of bite-sized pieces, there are, I think, certain components at this level that we should be able to do and being allowed to do those” (Intern, Participant #14).

Participants described low autonomy by the absence of decision-making and being treated as more of a “technician” in the operating room. This was described by residents at all levels, including interns, who noted that cases with low autonomy was where their participation was limited to holding a camera in a laparoscopic case or only closing skin.

“If you’re just holding a Bovie and having them [attendings] basically show you what to do with a right angle, and exposing tissue to you showing you the plane, and you just Bovie in between, you’re

not really making a decision, you’re just — any knucklehead can do that” (Senior Resident, Participant #23).

Theme 2: Intrinsic factors unique to residents and attendings can augment or inhibit the autonomy within a case

Participants identified several intrinsic factors unique to both residents and attendings that can impact the autonomy received in a case. Residents described how their own personality, reputation in the program, prior operative experience, or prior clinical exposures can impact autonomy. These traits could carry both positive and negative valence. For instance, residents who are “shy, timid, or quiet” might have a more difficult time receiving the autonomy they feel they deserve because of how they are perceived, even if equally skilled to their more outgoing counterparts. Participants commented that residents should be aware of how they may be perceived and have some insight into these implications of perceptions.

“Residents [need] to have a personal awareness of where they are actually, or what steps that they’re uncomfortable with, or where they are lacking” (Mid-Level Resident, Participant #16).

In regard to specific attending characteristics, residents noted that attending personality, experience, and confidence can also impact the autonomy they are granted during an operation. Participants indicated that an attending’s confidence can be contagious and lead to greater resident confidence and operative performance. Residents identified attendings that used phrases such as “I can fix whatever you mess up” or those who exuded a calm, collected demeanor in the OR, as those attendings that provided greater independence. Participants noted that attending experience and years outside of training did not necessarily correlate with allowance of greater autonomy, citing attending surgeons at all levels of experience who promoted or inhibited autonomy in the operating room.

Finally, participants commented on how an attending surgeon’s comfort in teaching, teaching ability and competence, and opinions on teaching impact the independence they are granted in the OR. Residents often described attendings who were less likely to provide independence as either poor teachers or having low opinions of teaching. Participating in cases with these attending surgeons was often characterized as “painful,” “difficult,” and “not desirable” and some participants went as far as suggesting that residents should not be expected to cover these cases if there was no educational benefit. Despite this, participants acknowledged that teaching itself is a profession for which many surgeons do not receive any training and might not be aware of their deficiencies as a teacher.

“I think attending personality is a big component because there are just some people that are so controlling and perfectionistic. It’s not

because they don't necessarily trust you, but they feel like they can only do it the way they want it done." (Intern, Participant #9).

Theme 3: Behaviors exhibited by both residents and attendings can augment or inhibit autonomy when tenuous within a case

Participants identified certain behaviors in the operating room that could augment or inhibit autonomy when resident autonomy was tenuous within a case. Behaviors used by residents to enhance autonomy included being proactive or taking the lead in a case, whereas taking a passive role could inhibit autonomy. Opportunity for residents' assertion of autonomy might occur with other components of the case, such as set-up and positioning, leading the sterile prep and drape, setting up operative instruments on their side, and keeping the operative instruments on their side, particularly for laparoscopic cases. During the case, residents made it a habit to be proactive in asking for instruments or equipment as well as bargaining for more time to complete certain tasks in an attempt to keep the case from being "taken away" and relegated to the role of an assistant.

"I always take the instruments now. I've gotten much bolder about being the one – I never give up the working instruments. I keep everything on my side." (Mid-Level Resident, Participant #7).

Consequently, attending behaviors in the OR can have a similar effect on autonomy. Strategies noted by participants included ingraining and celebrating resident successes, building resident confidence, challenging residents appropriately, and allowing for appropriate struggle. Negative behaviors included were when attendings acted in a way that inhibit autonomy, most notably taking away a case and failing to relinquish control, especially once an obstacle was overcome. Other negative behaviors described by residents included being treated at a lower level than their perceived ability.

"He allowed me to get to the point where I said, 'I can't really do this anymore,' and sort of took over at that point. But didn't fully take over – I mean, that was the really neat part, was that he didn't take over, he just helped me get over that hump, and then, again, I went back to leading." (Mid-Level Resident, Participant #7).

Theme 4: Collaborative factors and the relationship between residents and attendings can augment the autonomy within a case

Participants identified the need to build relationships with attendings and the collaborative components of these relationships that contribute to operative independence and meaningful autonomy. Relationship building requires familiarity both in and out of the operating room to facilitate entrustment. Barriers to relationship building included rotation schedules and case assignments which made it difficult for residents to work with the same attending time after time. Several residents cited the benefits of apprenticeship models or operative days doing the same case with the same attending in order to quickly build these relationships. Residents also acknowledge the difficulties attending surgeons face when operating with a resident they do not have a previous relationship or experience with and the struggle attending surgeons must face in trusting and giving more freedom and independence to that unfamiliar resident.

"I think that being able to walk that boundary is up to a surgeon and a trainee knowing each other well enough to allow some trust to evolve, which allows the trainee to be out in the water a little bit" (Intern, Participant #13).

In order to build a relationship, participants described collaborative factors and investments that must be made from both parties. From the trainee side, residents need to come to the operating room with the appropriate knowledge and preparation for the case. This was described by participants as knowing the steps of the operation, including preoperative set up of a procedure such as positioning, prepping, draping, and appropriate antibiotics, the general indications for the operation, and the pitfalls that can occur. Residents also described ways to communicate this knowledge and preparation to attendings, specifically through asking questions or facilitating a pre-operative discussion about the case. Other instances of communication and benefits of a strong relationship included the ability to have an intraoperative discussion to confirm the next steps or plot case progression. This communication was used to provide affirmation of the resident's knowledge, engagement, or preparation for the case to facilitate autonomy. Participants believed that demonstrating preparation for the operating room was a key component of early relationship building and entrustment.

"Your own preparation. So, you know the case, you watched a video of how to do it, you've done those skills before you read about the patient. And you know why you want to do, what you want to do." (Mid-Level Resident, Participant #18).

From the attending side, participants described the need for attending-led formalized goal and expectation setting for each operation. This could include identifying what the resident would like to achieve in the case or which components of a case a resident feels comfortable with or would like to try to accomplish independently. These discussions could also reinforce the previous trainee-side commitment of bringing the appropriate knowledge and preparation to the case. Participants described fewer instances of resident-driven goal and expectation conversations and emphasized that the lead should come from the attending-side. Residents identified and lauded several attendings who exhibited this behavior, including instances of communication the night before to discuss cases for the next day. Overall, participants believed that as part of the attending-trainee relationship, autonomy must be earned through resident preparation and attendings should create expectations, emphasizing that this relationship requires equal buy-in.

"They [attendings] are very happy to talk about the case mostly for decision-making pre-op. And then I think that gives them confidence that you're interested. And they're more willing to participate more actively." (Mid-Level Resident, Participant #16).

Theme 5: Extrinsic factors and pressures on residents and attendings can hinder autonomy both within a case and throughout residency training

Participants identified several barriers and extrinsic pressures that residents and attendings face that can hinder autonomy. These barriers or pressures may be encountered in the operating room, over the course of residency training, or in both settings. Some

factors specific to a case include the complexity of the case and the health and stability of the patient. Participants agreed that in cases when a patient's status was tenuous or in difficult cases such as takebacks or patients with multiple prior surgeries, they expect and agree that their autonomy should be limited.

General barriers identified in training for residents included the hospital culture, time required to provide meaningful autonomy and independence, and the rotation and operating room schedule specific to our institution. Hospital culture included the accepted importance of resident training and teaching from both attending surgeons, operative staff, and administration. Participants believed that all staff, including operating room nurses, circulators, scrub technicians, and anesthesia personnel need to be on board with a culture of teaching and independence to promote resident autonomy. Many participants cited instances of OR staff coming in conflict with this opinion, for instance, through safety reports filed because of resident independence in the OR.

"I think that sometimes the circulators and scrub techs don't understand that, yeah, we're trainees, but we're not preschoolers. I think that sometimes early circulators, they don't even know that we're doctors. They just think that we're people that are there, that are learning and don't know anything. So, I think that if we have better language to discuss us as trainees, it would help with this perception." (Mid-Level Resident, Participant #7).

Participants believed that the barriers attendings faced in providing autonomy included institutional pressures and metrics such as average case time, relative value units (RVUs), and overall productivity as well as concern for liability and complications due to trainee errors. Participants believe that the attending-patient relationship plays a significant role in the autonomy they receive, as patients may expect that the attending surgeon will be the only one performing the operation. The attending surgeon is the doctor they have seen in the pre-operative and office setting and built a relationship and trust with. Participants acknowledge that attendings probably feel a level of commitment to their patients and some conflict in involving trainees and the risk for error or a less refined end product.

"I would anticipate that there's also this little bit tug at your heartstrings. You [Attendings] know that you're giving this case to somebody less experienced. This is your patient. You don't want to do bad by them." (Intern, Participant #12).

Participants proposed potential solutions to address several of these barriers. One common solution included promoting, encouraging, or rewarding attending surgeons who promote a culture of teaching. Some ideas included designating teaching cases that reimburse at a greater rate based on level of trainee involvement or even publicly promoting those who exhibit best teaching practices. Teacher training could be provided to residents and attendings alike in order to promote these best practices and overall culture change.

"I think if we could focus on attendings that are actively interested in teaching, make more of an apprenticeship model, and have a lower expectation that all cases need to be covered by a resident, especially if there are attendings that are not really fruitful participants in terms of teaching residents ..." (Mid-Level Resident, Participant #16).

Theme 6: Residents as teachers and resident teacher development can parallel autonomy but also come into conflict with its progression

Some participants described the ultimate autonomy and end goal of autonomy as being able to teach the case to someone else. This could include walking a junior resident through a case with or without attending supervision or just walking an attending through a case while playing the role of the "operating surgeon." Some residents believe that they do not truly understand a case until they can teach it.

"I think, right, that's when you know you've mastered something, when you can teach someone else to do it" (Intern, Participant #10).

Many of these same residents believe that it is important for residents to develop excellent teaching skills during residency. Teaching can begin as early as intern year with teaching medical students on their clerkship or sub-internship and extend through chief year teaching more junior residents. Some participants emphasized the need for this experience early so they could be effective teachers as attendings. Through their own teaching experiences, many participants were able to emphasize with attendings about how challenging and difficult teaching is and how their own education is no small feat.

"It is our duty and our responsibility and our privilege to teach juniors below us in every aspect of patient care, whether that's in the operating room, in the emergency ward, on the floor, anywhere" (Mid-Level Resident, Participant #7).

Beyond teaching and operating with more junior residents, participants universally agreed that there were benefits to operating with colleagues. Many residents believe that operating together fostered co-learning and discovery as residents brought different experiences to the operating room. Senior residents emphasized a willingness to be more aggressive with advancing a case in the OR with a colleague as opposed to a junior resident. In addition, operating with colleagues allowed residents to assess themselves in a non-competitive setting with their peers to have a better idea if they are progressing appropriately through residency.

"I guess if we were to operate together, it would be more of a colleague, sort of collegial thing. Bounce ideas off without major criticisms and stuff. And we can show our insecurities and be like, 'Hey, did we do it right here? Is it okay? Is this good?'" (Senior Resident, Participant #25).

However, not all residents believe that teaching is the ultimate autonomy or the end goal of surgical residency training. In fact, several participants, particularly senior residents, identified how teaching and autonomy while learning to operate can conflict with one another. A senior resident taking a junior resident through a case potentially takes away the opportunity for the junior resident to learn from an expert surgeon, at the expense of the senior resident learning to teach. Teaching may also not be a priority for residents who do not want to pursue a career in academic medicine or working with trainees. Some of these participants believe that

while learning to teach is a bonus, they believe that at the end of residency it is more important to be able to complete a case safely with whatever level of assistance provided. Developing skills as a teacher can run in parallel with autonomy and gaining independence but is not necessarily a requirement of surgical training. Teaching mastery is a step beyond independent practice but not the end goal of residency and not a priority for all trainees.

“I think that depends on how much the person values teaching ... So, I don't think autonomy is necessarily being able to take somebody else through it. I think autonomy is if I'm in the room by myself - whether or not I'm helping somebody do it or whether or not I'm doing it - can we get the operation done?” (Senior Resident, Participant #21).

The autonomy “tightrope”

Taking these 6 themes together, we proposed the idea of an autonomy “tightrope,” where residents progress toward a goal of independent practice while balancing factors, both within a case and over the course of residency training, that can impact the autonomy they receive (Fig. 1). These themes do not exist independently in a bubble and their collective interactions require a “balancing act” to maintain appropriate autonomy. Some of these elements, such as resident and attending intrinsic factors, are not easily modifiable, as opposed to resident and attending behaviors, which in real-time can tilt residents to an appropriate, or consequently, inappropriately level of autonomy dependent on the behavior. Extrinsic pressures are felt by all parties as a challenge to autonomy and requires systemic support to cultivate a learning environment in the operating room. The relationship between residents and attendings further strengthens autonomy; however, unevenness in commitment to this relationship, very much like a poorly balanced pole for a tightrope walker, will lead to a collapse of autonomy. Finally, while residents agree that development of

resident teachers can occur simultaneously with operative autonomy, some see it as a step beyond independent practice and not necessarily a requirement of surgical training. It exists as an optional path for the resident who values teacher development as a part of his or her surgical training.

Discussion

This study describes how general surgery residents define meaningful operative autonomy, how that autonomy is progressively granted to them over their course of training, and how that autonomy may fluctuate within a case. An important finding is that while residents all agree that by the end of surgical residency, they should theoretically be ready to enter independent practice, not all residents believe that teacher development takes priority in their operative training. Some residents emphasized that being able to teach a case is the only way to truly understand and master it, consistent with the “see one, do one, teach one” mantra, along with evidence that being able to teach a procedure may result in better overall performance than independent practice alone.¹⁰ In conflict with this, other residents emphasized that teacher development is only critical if it aligns with your career goals. This highlights an identity conflict like those described by Mobilio et al. where residents occupy the dual role of worker and learner in the OR, but now with residents playing a mix of the dual roles of learner and teacher.¹¹ Not only does being a teacher and developing teaching ability and skills come into conflict with the resident's own autonomy and operative independence, but also limits the learning of their peers as they lose an opportunity to learn from a master surgeon for the benefit of another resident's teacher development.

The tension between autonomy and teacher development may further propagate the previously described autonomy gap.^{6,7} Trainees who value their own autonomy over development of teaching skills may continue to hold this sentiment as attending surgeons. If these surgeons choose a career in academic medicine and are involved with the training of residents, this mismatch of

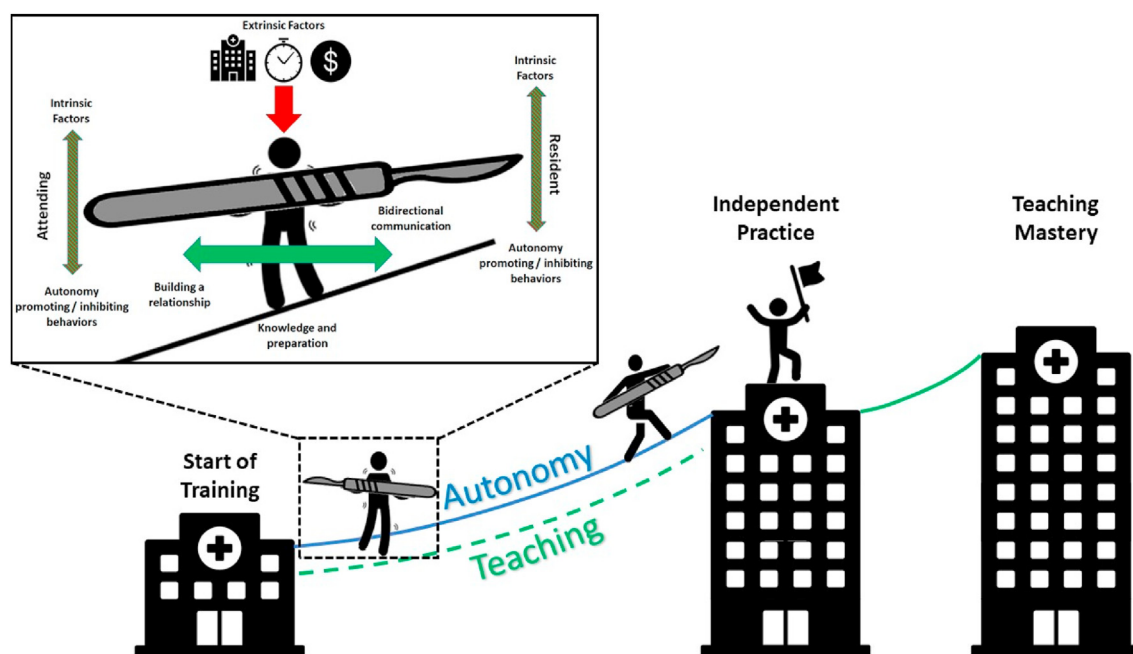


Fig. 1. Pictorial representation of the resident description of autonomy. Development of resident teachers can occur simultaneously, is described as a step beyond independent practice, but is not necessarily a requirement of surgical training. The inset demonstrates the balancing of factors impacting autonomy within a case, analogous to “walking a tightrope” to maintain an appropriate level of autonomy.

ideals may only further this divide. Participants universally acknowledge the difficulties in operating with someone who does not prioritize and grant meaningful resident autonomy and exhibit a preference for training with surgeons more aligned with their own ideals. Identifying and championing surgeon educators as role models of resident training, offering teaching training to those without the prerequisite skills, or minimizing trainee involvement with attendings who prioritize their own autonomy over the development of trainees may consequently align values and thus narrow the autonomy gap.

Our findings of what factors impact autonomy within a case mirror many of those previously described. Factors unique to the resident, including postgraduate level, previous case experience, reputation, confidence, self-entrustment, knowledge of limitations, and personality have all been previously found to impact the initial autonomy granted in a case.^{12–17} Chen et al. describes three domains of the resident that impact initial autonomy, as opposed to one variable related to attendings and one variable related to the context, suggesting that perhaps resident's themselves play the biggest role in their own autonomy.¹² During a case, behaviors and actions taken by residents can also augment or hinder autonomy. While many residents described what behaviors they perform to augment their autonomy, such as taking the lead in a case and calling for and holding the operative instruments, they were less likely to describe any specific red flag behaviors that hinder autonomy. These red flag behaviors, such as hesitancy, failure to progress, or making unsafe maneuvers have been previously acknowledged from the attending perspective.^{13,15} While negative behaviors were not mentioned specifically by participants, they did acknowledge that their own real time performance plays a role in the autonomy granted with both positive and negative valence.^{4,18,19}

Factors unique to the attending surgeon have been previously described as impacting the initial autonomy received and includes but is not limited to attending confidence, experience, comfort teaching, and personal teaching philosophy.^{12,13,16,18–21} Most notably, participants described attending confidence as being contagious. When attending surgeons portrayed confidence in their own abilities, either explicitly or through their actions, residents described being at ease with improved performance and confidence of their own. This elaborates on previous findings that resident self-confidence and sense of ownership improves when more autonomy is granted.¹⁴ Attending behaviors in the operating room have the ability to tip the level of autonomy in one direction as residents walk a “tightrope” during the case. Expert surgical teachers use techniques to foster and improve both trainee intrinsic and extrinsic motivation.²² These include creating a teaching environment that allows for safe struggle and even allowing for manageable mistakes to promotes resident growth while maintaining the balance of the current level of autonomy.^{16,22–25} On the other hand, maneuvers characterized as “false teaching” such as guiding the resident through an operation by setting up every move without any meaningful decision making, pushes the resident off the autonomy tightrope to a level of low autonomy.¹¹ Residents universally recognize this role as being a technician in the operating room, using whatever instrument they are given and dissecting or cutting whatever tissue is presented to them without independent thought.

Together, the behaviors exhibited by both residents and attendings can either promote autonomy by pushing residents to a level of challenge and modest discomfort or inhibit autonomy by allowing residents to fall back to a level of training which they have already mastered. This concept is similar to that of Vygotsky's zone of proximal development (ZPD), previously described in the surgical education literature.^{13,25,26} The ZPD is a region between what

learners know how to do and what they cannot do. The tightrope straddles this zone, and this variable region can be traversed with guidance, support, and an appropriate environment to foster resident skill progression. Attendings and residents can act in a way to sustain themselves within this zone or falter to the lower zone of autonomy, such as pure technical skill development or functioning as a technician in the OR.

The behaviors, experiences, and characteristics of residents and attendings all contribute to the relationship between the two parties that when present, can augment autonomy within a case. Residents believe that there is an unwritten agreement between the two parties and their investment in this relationship should be reciprocated by attendings. Residents defined their investment by preparing for the operating room similarly to other investigations, including knowledge of the patient, pathophysiology of the surgical disease, indications for the operation, surgical anatomy, and procedural steps and potential complications.²³ They also emphasized ways to express this knowledge and preparation to attendings through targeted questions and preoperative discussions as potential entrustment evidence.^{12,16} In return for their preparation, residents expect goals and expectations of autonomy be fulfilled during the ensuing case.

Unfortunately, this perfect tradeoff does not always occur and can be a source of frustration for residents. A few attending surgeons were lauded for their efforts in establishing goals and expectations before the case, an effort that is thought to be a shared responsibility between the two parties.¹⁷ However, an equal or greater number of attendings were mentioned who enable no such discussion, and subsequently, no meaningful autonomy. Residents perceive this lack of shared responsibility having more to do with attendings; as historically, goals of an operation are identified only half the time by residents, about a quarter of the time by attendings, and a discussion held 20% of the time between the two parties.²⁷ Interventions aimed to improve communication and learning goal setting such as skill competencies, standardizing goals, or preoperative timeouts may enhance this relationship and promote continued cooperation by all parties.^{17,28}

Residents described both extrinsic factors as well as pressures and barriers they face in achieving meaningful autonomy. Some of these, like case difficulty and patient instability, have been previously described and generally are accepted by residents as both non-modifiable factors and a reasonable exemption to more operative independence.^{4,12,15,21,23} Residents also acknowledge that attending surgeons face many pressures, including ultimate responsibility and scrutiny for outcomes, time and reimbursement metrics, as well as patient expectations.^{18,21} The attending surgeon-patient relationship is one built on trust with the expectation and understanding that the patient's best interest is placed in the surgeon's hands in the OR. Residents acknowledge that their role as learners directly interferes with that trust and drives conflict in the attending surgeon's management of their own dual identity of teacher and worker.¹¹ Some proposed solutions included improved patient education to discuss the role of the resident in the operation as well as potentially rewarding and reimbursing attending surgeons for the time lost in designating teaching cases. Potential solutions and interventions are aimed at promoting a culture of teaching within the operating room, a surgical residency, and within an institution.

Limitations of this study include the small sample size as well as the fact that it was performed at a single, large academic institution and might not be generalizable to other programs. Specifically, some of the barriers to autonomy and potential solutions presented by participants might be specific to our institution. Program size, use of apprenticeship models, and exposure to resident teaching and cooperative learning in the operating room may vary across

institutions. The author, who conducted the interviews, was a general surgery resident who knew the participants, which may have influenced responses and the language used by participants. Residents who participated chose to do so voluntarily, thus our study might be subject to selection bias. Despite these limitations, the study does provide a unique description about the definition and evolution of autonomy from the resident perspective and the conflicts residents may face balancing operative autonomy with teaching. Future work can investigate how attending surgeons view this same potential conflict that residents face.

Conclusion

General surgery residents define operative autonomy as a pathway of progressive independence, beginning with skill development and progressing to independent decision-making with a goal of readiness for independent practice by the end of surgical training. Within a case, autonomy may fluctuate, influenced initially by resident- and attending-specific factors and in real-time by the relationship between and behaviors exhibited by these two parties. Residents walk a tightrope to maintain autonomy both within a case and throughout residency. Most notably, our findings show that resident teacher development can run in parallel to this pathway but is not a priority for all trainees and not part of the autonomy continuum. These residents may later graduate to become surgical attendings who lack the necessary teaching skills to provide adequate autonomy to future trainees. Teaching would need to remain an expectation of all residents in order to break this cycle. Residents who view teaching as a key component of autonomy must balance the potential conflict they may face not only with their own autonomy and independence but also the autonomy and development of their peers.

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Author contributions

D. Cassidy was directly involved in the design and implementation of the study, collection of data via focus groups, review of transcripts including analysis and interpretation of data, writing the manuscript, and approving the final version for submission. S. McKinley was directly involved in the coding of the focus groups and analysis of data, providing revisions, and approving the final manuscript. J. Ogunmuyiwa was involved in the collection of data and functioned as an independent observer by recording field notes and debriefing following each interview. E. Petrusa was involved in the design of the study, analysis and interpretation of data, providing revisions and approval of the final manuscript. J. Mullen and R. Phitayakorn provided oversight of the project as well as providing critical revisions and approval of the final manuscript for submission. M. Kim was involved in the data generation, interpretation, and analysis as well as directly involved in the oversight of the project, providing critical revisions, and approval of the final manuscript for submission.

Declaration of competing interest

The authors (D.C., S.M., J.O., J.M., R.P., E.P., and M.K.) have no conflicts to disclose.

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Appendix A. Representative questions from the semi-structured interview guide regarding operative autonomy

How do you define operative autonomy at your current level of training?
What factors should influence the autonomy granted at your postgraduate level?
What are some barriers that prevent you from receiving the autonomy you think is appropriate?
What communication or planning do you have with the attending before the case?
Is there anything that you do that enhances or detracts from the autonomy you receive?
Is there anything the attending does that enhances or detracts from the autonomy you receive?
What feedback do you receive and expect in the operating room?
What degree of autonomy should be permitted to senior residents teaching more junior residents?
What are your thoughts on autonomy with non-operative components of the case?
Is there anything that can be done to better improve autonomy in the OR?

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