The American Journal of Surgery 217 (2019) 276–280

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Bridging the gap: The intersection of entrustability and perceived autonomy for surgical residents in the OR

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ARTICLE INFO

Article history:
Received 16 April 2018
Received in revised form
27 June 2018
Accepted 23 July 2018

Keywords:
Entrustment
Entrustability
OpTrust
Autonomy
Surgical education

ABSTRACT

Background: Faculty entrustment decisions affect resident entrustability behaviors and surgical autonomy. The relationship between entrustability and autonomy is not well understood. This pilot study explores that relationship.
Methods: 108 case observations were completed. Entrustment behaviors were rated using OpTrust. Residents completed a Zwisch self-assessment to measure surgical autonomy. Resident perceived autonomy was collected for 67 cases used for this pilot study.
Results: Full entrustability was observed in 5 of the 108 observed cases. Residents in our study did not report full autonomy. Spearman's rank correlation coefficient identified that resident entrustability was positively correlated with perceived resident autonomy ($\rho = 0.66$, $p < 0.05$). Ordinal logistic regression assessed the relationship between resident entrustability and autonomy. The relationship persisted while controlling for PGY level, gender, and case complexity (OR = 8.42, SEM = 4.54, $p < 0.000$).
Conclusions: Resident entrustability is positively associated with perceived autonomy, yet full entrustability is not translating to the perception of full autonomy for residents.

Introduction

Addressing the autonomy gap in surgical resident education is a critical and urgent need.[2] It is a distressing statistic for the surgical profession that 23% of graduating surgery residents believe the current training curriculum does not fully prepare them to practice as independent surgeons.[1] Resident training cannot culminate with supervised practice, but rather trainees must achieve full entrustment from an attending resulting in autonomy in order to develop the complex skillset needed to become independent practicing surgeons.[3,4] Therefore, it is imperative for faculty surgeons to actively create high-level surgical experiences for residents.[4] With the emergence of increased faculty supervision, which is inherently positive, the unintended consequence has been failure to allow for graduated responsibility in the operating room which creates different patient safety concerns.[2,3,5] Integrative solutions incorporating both entrustment educational models and procedural autonomy assessments into surgical education and training programs may help advance resident progress and aid in closing the autonomy gap concurrent with appropriate faculty supervision.

Autonomy and entrustability are closely linked, yet they are distinct operative behaviors. Resident entrustability helps inform and advance resident autonomy.[6] Faculty entrustment decisions tend to drive how residents' exhibit entrustability in the operating room. Faculty surgeons who demonstrate progressive intraoperative entrustment can help propel resident entrustability forward.[6] In turn, trainees gain intraoperative responsibility and greater surgical autonomy. Even though faculty-based entrustment decisions drive entrustability, they are not the only factors in the

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https://doi.org/10.1016/j.amjsurg.2018.07.057
0002-9610/

development of operative autonomy. Residents, as adult learners, must actively negotiate for intraoperative autonomy by demonstrating strong clinical ability, high investment in each case, and keen consideration of critical moments.[4,7,8,9]

Investigation in the studies of entrustability and autonomy are increasing in surgical educational research.[8,10] These studies have produced insightful research on the intricate mechanisms of each behavior independently, yet no known study has examined the intersection of these two behaviors. The critical transition from resident entrustability to autonomy needs to be better understood. To bridge the gap, this pilot study examines the relationship between observed entrustability behaviors and self-perceived autonomy among surgical residents. We sought to analyze the association between third-party observational measurements of resident entrustability behaviors using OpTrust scoring with the perception of resident autonomy in Zwisch Scale self-assessments. We hypothesized that we would find observed resident entrustability to be positively associated with self-perceived resident autonomy.

Methods

Study design

From November 2016 to June 2017, an observational study was undertaken at the University of Michigan Hospital. Faculty-resident intraoperative interactions were scored using the OpTrust tool, a validated objective entrustment measurement tool.[11,12] OpTrust emphasizes observable outcomes in the form of descriptive benchmarks for assessment of progressive entrustment and was created in keeping with the ACGME Milestones structure. The tool can be used across surgical specialties with variable years of resident and faculty training. OpTrust scores five observable domains: types of questions asked, operative plan, instruction, problem solving, and leadership by the surgical resident. The domains are scored on a scale of 1–4, where a score of 1 illustrates low entrustment/entrustability and a score of 4 indicates full entrustment/entrustability. This tool enables trained third-party raters to measure faculty entrustment behaviors and resident entrustability behaviors independently. The tool provides a global overview of faculty entrustment and resident entrustability; it also records a granular measure of each of the five contributing domains. Both the domain measurements and overall OpTrust score enable investigators to quantify entrustment and entrustability behaviors to provide individualized feedback to resident and faculty members.[11] For this study, we utilized the global OpTrust score as our measure of resident entrustability. OpTrust has a high degree of inter-rater reliability (IRR); all domains demonstrated strong IRR (ICC1 and ICC2 > 0.80) indicating the reliability of individual rater's ratings for each of the faculty entrustment domains and resident entrustability domains.[11] Resident autonomy was measured using the Zwisch Scale, a validated assessment tool that measures self-reported resident autonomy during the critical portion of a case.[23] This study was approved by the University of Michigan Institutional Review Board.

Measures

Faculty entrustment and resident entrustability scales (1–4) were measured by OpTrust. Cases were observed by trained raters, which included: 4 surgical residents, 2 non-clinical behavioral research specialists, a medical student, and a surgical education faculty member. Without interfering in the faculty-resident interaction, raters noted behaviors, verbal/nonverbal communication, and interaction processes. Immediately following each case, raters reviewed their notes and completed an OpTrust assessment. In OpTrust feasibility studies, faculty and residents have reported that entrustment/entrustablility behaviors are similar in observed versus non-observed cases.[13] Measures were collected for controlling factors: PGY level, years of faculty experience, observation duration and month, and case difficulty. PGY level was collected from the Office of Surgery Education. We obtained “Year of faculty experience” from the Department of Surgery administrative offices. Observation month was based on the month the observation took place. Observation duration was measured by recording the amount of time (in hours) the case was observed. “Case Complexity” was reported via the Zwisch Scale measurement. It was measured on a 3-point scale: 1 = easiest 1/3, 2 = average, and 3 = hardest 1/3. The Zwisch Scale, a validated measurement tool of perceived autonomy in the operating room, was administered to residents via the Department of Surgery MedHub resident evaluation platform directly following each observed case.[14] Resident participation in completing the Zwisch Score for each case was highly encouraged, but voluntary. The Zwisch Scale scores resident autonomy on 4 ordinal levels as related to performing the “critical portion” of a case. At the foundational level is “show and tell”, second level is “active help”, third level is “passive help”, with the most advanced level being “supervision only”.[14]

Participants

108 OpTrust case observations took place across general, plastic, thoracic, and vascular surgical specialties. Zwisch Scores were received from residents for 67 of the 108 cases for the current pilot study. Critical case sampling, a type of purposeful sampling, was utilized in selecting cases to generate variation in type of operation, case difficulty, faculty-resident pairings, faculty experience, and resident training level (PGY1-PGY6). All Department of Surgery faculty and residents were informed about the scope of the study and consented to participation prior to surgery. 28 faculty and 38 residents were observed.

Statistical analysis

Resident entrustability was compared by case observation characteristics by independent t-tests or analysis of variance (ANOVA) and perceived autonomy was compared using Mann-Whitney U, or Kruskal-Wallis tests and results are reported in Table 1 (Please note, OpTrust scores are treated as continuous variables with reported means. Zwisch scores are treated as ordinal variables with reported medians). Spearman's rank correlation coefficient was used to analyze the strength and direction of resident entrustability with perceived resident autonomy. Since perceived autonomy is measured on an ordinal scale, ordered logistic regression was used to assess the relationship between resident entrustability and perceived resident autonomy while adjusting for PGY level, gender, and case complexity. All analyses were conducted in STATA15[15] and significance was set at $p < 0.05$.

Results

As reported in Table 1, observed resident entrustability was significantly and positively correlated with perceived resident autonomy ($\rho = 0.66$, $p < 0.05$). Both observed resident entrustability and perceived resident autonomy differed significantly by PGY level ($p < 0.00$ and $p = 0.002$, respectively); however, neither measure

Table 1
Observed resident entustability and perceived resident autonomy by case characteristics.

	Observed Resident Entrustability* Mean (SD[a])	P-Value	Perceived Resident Automony** Median (IQR[b])	P-value
PGY Level				
1 - 2	1.56 (0.56)	<0.00	2 (1)	0.002
3 - 4	2.27 (0.75)		3 (1)	
5 - 6	2.84 (0.73)		3 (1)	
Gender				
Female	2.33 (0.88)	0.39	2 (1)	0.375
Male	2.22 (0.85)		2 (1)	
Case Complexity				
Easiest 1/3	2.98 (0.69)	0.0024	3 (1)	0.136
Average	2.36 (0.93)		2 (1)	
Hardest 1/3	1.88 (0.60)		2 (2)	
Correlation between observed entrustability & perceived autonomy	$\rho = 0.66$, $P < 0.00$			

*Measured with OpTrust Scores.
1 = low entrustment/entrustability.
2 = medium entrustment/entrustability.
3 = high entrustment/entrustability.
4 = full entrustment/entrustability.
**Measured with Zwisch Scale.
1 = show and tell.
2 = active help.
3 = passive help.
4 = supervision only.
[a] Standard deviation.
[b] Interquartile range.

differed by resident gender. Observed resident entrustability was statistically different by case complexity, but perceived resident autonomy was not ($p = 0.0024$, $p = 0.136$). The significant relationship between observed resident entrustability and perceived autonomy persisted while adjusting for PGY level, gender, and case complexity in the multivariable ordered logistic regression analysis (or = 8.42, se = 4.54, $p < 0.000$). Table 2 details the ordered logistic regression analysis of perceived resident autonomy on observed resident entrustability adjusted for case characteristics; this ordered logit assigns probabilities that values will fall below a certain threshold. The predicted probability from the ordered logistic regression indicates the probability of perceiving “show and tell” (the lowest level of autonomy) decreased as entrustability increased and the predicted probability of perceiving “passive help” (the highest level of autonomy) increased as entrustability increased [Fig. 1]. Although, full entrustability was observed in the OR in 5 of the cases none of the residents in our study reported “supervision only” or full perceived autonomy. The predicted probability after collapsing “passive help” and “supervision only” into a single rating still increased as entrustability increased.

Discussion

This pilot study reveals that observed resident entrustability is indeed positively associated with perceived resident autonomy. It is encouraging to find a positive association between these interconnected intraoperative behaviors, as it affirms that resident autonomy self-assessment measures align well with third-party observational entrustability measurements. However, this alignment does not appear to be entirely consistent. In this study, we found that full entrustability is not translating to the perception of full autonomy for residents. OpTrust raters observed full entrustability in 5 of the observed cases, yet no residents reported full autonomy with Zwisch scale measurements. This could be evidence that the autonomy gap in surgical training may be in part related to resident self-perception rather than true lack of readiness.

Table 2
Ordered logistic regression analysis of perceived resident autonomy on observed resident entrustability adjusted for case characteristics.

	Perceived Resident Autonomy OR (SE)	P-value
Observed Resident Entrustability	8.42 (4.54)	<0.001
PGY Level		
1 - 2	1	
3 - 4	8.68 (7.40)	0.011
5 - 6	0.92 (0.79)	0.925
Gender		
Male	1	
Female	0.47 (0.33)	0.278
Case Complexity		
Easiest 1/3	1	
Average	2.13 (1.76)	0.361
Hardest 1/3	0.49 (0.50)	0.486

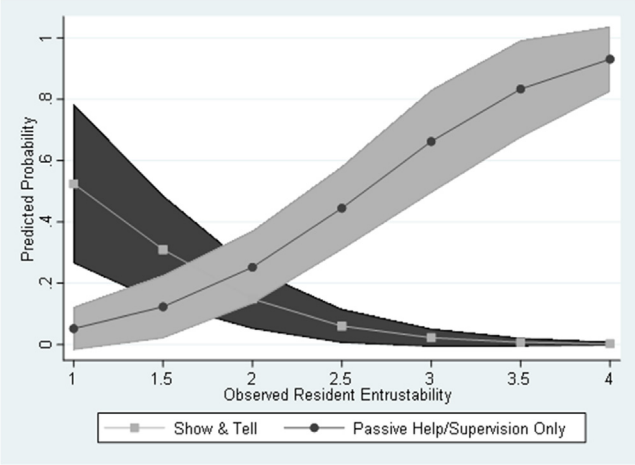

Fig. 1. Predicted probabilities of residents perceiving "show & tell" or "passive help/supervision only" at various levels of observed resident entrustability.

We have found that by utilizing entrustment educational models in tandem with procedural autonomy assessments, a more complete picture of where entrustability intersects with autonomy emerges. Each measure on its own reveals significant evaluative information for the teacher and the learner. Mapping entrustment and entrustability behaviors are key to faculty and resident development when implementing a competency-based assessment framework, in particular Entrustable Professional Activities (EPAs).[16,17] At the same time, autonomy measurements are essential in tracking trainee progress towards clinical competency and establishing benchmarks for independent practice.[18,19] When taken together, these measurements provide a broad overview of the intraoperative educational environment for surgical educators.

Entrustability interventions have the potential to address autonomy gaps in surgical training.[10,20] A unique characteristic of OpTrust is that it provides an assessment of faculty entrustment and resident entrustability, as well as granular measures of each of the five contributing behavioral domains: types of questions asked, operative plan, instruction, problem solving, and leadership by the surgical resident. Both the overall OpTrust score and the granular domain measurements enable assessors to provide individualized descriptive feedback to both faculty and residents.[11] OpTrust is able to detect areas of opportunity for increasing resident entrustability.[12] If areas for improvement and exact behavioral patterns can be identified, there is potential to increase entrustability behaviors that result in higher resident self-confidence and a stronger belief in one's ability to perform autonomously. When appropriately directed, increased entrustability should lead to increased autonomy over time with a given procedure. Resident development inventions that educate learners on entrustable behaviors, personality trait alignments, mental model awareness, and enhanced autonomy have shown promise in our study population. Additionally, OpTrust has the capability to pinpoint areas for faculty interventions, specifically for faculty surgeons who are consistently not advancing entrustment to residents. Faculty entrustment is the primary driver of resident entrustability; thus shortfalls in faculty entrustment can lead to lower exhibited entrustability of residents.[6] Unfortunately, resident autonomy studies have found that faculty rarely grant full autonomy to residents. SIMPL (a mobile Zwisch Scale application) studies have shown that “Supervision Only” autonomy is achieved for only a fraction of core procedures, even for residents who are in their final 6 months of training.[21] To combat this, faculty development utilizing OpTrust can help faculty surgeons switch from surgical auto-pilot to consciously self-regulated educator which can further entrustment and create opportunities for resident entrustability and autonomy.[22]

Designing a practical application for an evaluative framework using OpTrust to augment autonomy measurements may be beneficial for the advancement of resident training. The Zwisch Scale is a valuable validated procedural micro-assessment tool that specifically looks at resident autonomy during the critical portion of a case.[23] These micro-assessments of autonomy have high facility; they are quick to complete, automated, and provide real-time results.[21] With continuous collection of resident performance data, Zwisch provides much needed ongoing quantitative procedural assessment.[14,21] OpTrust is a more robust evaluation tool and as such requires greater time and resources for rater training and observational analysis. It is best used intermittently to tactically identify and develop faculty entrustment and resident entrustability skills. OpTrust assessments have the ability to determine behavior areas where growth is needed. Faculty and residents receive tangible feedback that can lead to the critical progression toward resident independence. Another distinct facet of OpTrust is as a third-party observational tool it has the capacity to uncover the unconscious behaviors that may hold back the progress of both residents and faculty.[12] Examining these behaviors may provide insights that advance the degree of educational effectiveness in the operating room to move residents to the final stages of readiness for independent practice.

It is important to note the limitations of this research. This study was conducted at a single academic institution where the faculty-resident participant and observation numbers were statistically significant, but were overall small in sample size. Therefore, these results may not be generalizable and will need to be verified using larger populations. Due to the limited number of faculty/resident pairings we were able to observe, there were inequities in gender representation and faculty experience in these pairings. Measures were collected for known confounders, including: PGY level, years of faculty experience, observation duration and month, and case difficulty. However, additional confounders could be identified and explored. To our knowledge, this is the first time an objective measurement of faculty entrustment and resident entrustability has been studied in relation to resident perception of procedural autonomy. We measured the perception of autonomy from the resident perspective, not faculty perceptive, which is where most of the research with the Zwisch Scale has been performed to date.[14] Since resident autonomy measures are self-reported, there is a possibility of bias. To advance knowledge in this area, we are partnering with other health systems to conduct a multi-institution OpTrust study. This study will include faculty and resident-focused educational interventions that will explore how entrustment feedback affects faculty entrustment and resident entrustability behaviors, and how this impacts resident and faculty perspectives of autonomy. The Department of Surgery at Michigan Medicine is now a member of the PLSC and is adopting SIMPL, a digital application autonomy assessment tool. We are hoping to collaborate with the PLSC in order to use SIMPL data to map faculty perception of autonomy and observed faculty entrustment in future studies.

Conclusions

When comparing OpTrust measurements of observed resident entrustability with Zwisch scale scores of perceived resident autonomy, we found that resident entrustability is positively associated with perceived autonomy. However, full entrustability is not translating to the perception of full autonomy for residents. Although these findings require validation with a larger population, they have the potential to enable surgical educators to better

understand the relationship between demonstrated resident entrustability and the transition to autonomous practice. Integrating the OpTrust entrustability scale with the Zwisch procedural autonomy assessment tool can provide a valuable evaluative framework for clinical training that may help advance resident progress and aid in closing the autonomy gap.

Funding

This work was supported by the Josiah Macy Jr. Foundation Board Grant #B15-05 and the University of Michigan Graduate Medical Education Innovations Grant.

Author conflict of interest disclosures

None.

Access to data and data analysis

Principal Investigator, Gurjit Sandhu PhD, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

References

1. Coleman JJ, Esposito TJ, Rozycki GS, Feliciano DV. Early subspecialization and perceived competence in surgical training: are residents ready? *J Am Coll Surg*. 2013;216(4):764–771.
2. Hashimoto DA, Bynum IVWE, Lillemoe KD, Sachdeva AK. See more, do more, teach more: surgical resident autonomy and the transition to independent practice. *Acad Med*. 2016;91(6):757–760.
3. Brunett P. Autonomy versus control: finding the sweet spot. *Acad Emerg Med*. 2013;20(9):952–953.
4. Aggarwal R. Entrustment, autonomy, and performance in the operating room. *Surgery*. 2015;158(4):1113.
5. Scally CP, Sandhu G, Magas C, Gauger PG, Minter RM. Investigating the impact of the 2011 ACGME resident duty hour regulations on surgical residency programs: the program director perspective. *J Am Coll Surg*. 2015;221(4):883–889. e881.
6. Sandhu G, Thompson-Burdine J, Nikolian VC, et al. Association of faculty entrustment with resident autonomy in the operating room. *JAMA Surgery*. 2018;153(6):518–524.
7. Moulton C-A, Regehr G, Lingard L, Merritt C, MacRae H. Operating from the other side of the table: control dynamics and the surgeon educator. *J Am Coll Surg*. 2010;210(1):79–86.
8. Young KA, Lane SM, Widger JE, et al. Characterizing the relationship between surgical resident and faculty perceptions of autonomy in the operating room. *J Surg Educ*. 2017;74(6):e31–e38.
9. Sullivan AM, Alseidi A, Kwakye G, Smink DS. Assessing residents' readiness for OR autonomy: a qualitative descriptive study of expert surgical teachers' best practices. *J Surg Educ*. 2017;74(6):e15–e21.
10. Rekman J, Gofton W, Dudek N, Gofton T, Hamstra SJ. Entrustability scales: outlining their usefulness for competency-based clinical assessment. *Acad Med*. 2016;91(2):186–190.
11. Sandhu G, Nikolian VC, Magas CP, et al. OpTrust: validity of a tool assessing intraoperative entrustment behaviors. *Ann Surg*. 2018;267(4):670–676.
12. Sandhu G, Magas CP, Robinson AB, Scally CP, Minter RM. Progressive entrustment to achieve resident autonomy in the operating room: a national qualitative study with general surgery faculty and residents. *Ann Surg*. 2016;265(6):1134–1140.
13. Nikolian VC, Sutzko DC, Georgoff PE, et al. Improving the feasibility and utility of OpTrust—a tool assessing intraoperative entrustment. *Am J Surg*. 2018;216(1):13–18.
14. George BC, Teitelbaum EN, Meyerson SL, et al. Reliability, validity, and feasibility of the Zwisch scale for the assessment of intraoperative performance. *J Surg Educ*. 2014;71(6):e90–e96.
15. Stata S. *Release 13*. College Station, TX: Statistical software. StataCorp LP; 2013.
16. Ten Cate O. Entrustability of professional activities and competency-bases training. *Med Educ*. 2005;39:1176–1177.
17. ten Cate O. Entrustment decisions: bringing the patient into the assessment equation. *Acad Med*. 2017;92(6):736–738.
18. Meyerson SL, Teitelbaum EN, George BC, Schuller MC, DaRosa DA, Fryer JP. Defining the autonomy gap: when expectations do not meet reality in the operating room. *J Surg Educ*. 2014;71(6):e64–e72.
19. Lucey CR, Thibault GE, ten Cate O. Competency-based, time-variable education in the health professions: crossroads. *Acad Med*. 2018;93(3S):S1–S5.
20. Timberlake MD, Mayo HG, Scott L, Weis J, Gardner AK. What do we know about intraoperative teaching?: A systematic review. *Ann Surg*. 2017;266(2):251–259.
21. George BC, Bohnen JD, Williams RG, et al. Readiness of US general surgery residents for independent practice. *Ann Surg*. 2017;266(4):582–594.
22. Bargh JA, Chartrand TL. The unbearable automaticity of being. *Am Psychol*. 1999;54(7):462.
23. DaRosa DA, Zwischenberger JB, Meyerson SL, et al. A theory-based model for teaching and assessing residents in the operating room. *J Surg Educ*. 2013;70(1):24–30.