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AOA Critical Issues in Education

Difference in Resident Versus Attending Perspective of Competency and Autonomy During Arthroscopic Rotator Cuff Repairs

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Background: A noted deficiency in orthopaedic resident education is a lack of intraoperative autonomy; however, no studies exist evaluating this issue. The purpose of this study was to determine whether there is a difference between resident and attending perception of resident competency and autonomy during arthroscopic rotator cuff repairs and whether increased perceived competency leads to more autonomy.

Methods: This study included 21 orthopaedic residents and 7 attendings from a single residency program. A survey was developed that included the previously validated Ottawa Surgical Competency Operating Room Evaluation (O-SCORE) and implemented novel arthroscopic rotator cuff repair questions concerning 5 key procedural steps determined by attendings. The survey assessed resident and attending perception of percent opportunity given and percent completed of each step and whether the resident could complete the surgery independently. Paired comparisons were conducted using the Wilcoxon signed-rank test. Agreement between residents and attendings was calculated using a linear-weighted Gwet's AC_2. A secondary analysis investigated resident perception of autonomy stratified by attending perception of competency using Kruskal-Wallis tests.

Results: One hundred forty-two surveys were completed over one academic year. Residents reported a 4-point higher median O-SCORE (34) than attendings (30; $p < 0.01$; agreement = 0.63). Residents perceived less opportunity compared with attendings, with a median opportunity to complete each step of 54% vs. 70% ($p < 0.01$; agreement = 0.39). Residents also perceived lower percent completed of the key steps compared with attendings, with medians of 52% vs. 61% ($p < 0.01$; agreement = 0.37). Resident perceived opportunity increased with higher attending reported O-SCOREs ($p < 0.01$) and percent completion of the key steps ($p < 0.01$). No statistically significant increase in perceived opportunity was observed the with post-graduate year (PGY) level ($p = 0.35$).

continued

Disclosure: The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article (http://links.lww.com/JBJSOA/A210).

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Discussion: This study demonstrated a significant difference in perception between residents and attendings regarding resident competency and autonomy during arthroscopic rotator cuff repairs. It also demonstrated that with increasing attending perception of competency, there was an increasing resident perception of autonomy, but there was no statistically significant difference of perceived autonomy based on the PGY-level.

In 1928, the American Medical Association approved surgical residency training based on an apprenticeship model in which trainees were taught by staff with graded autonomy[1-3]. Since the early 2000s, with duty hour restrictions, increases in institutional supervision policies, and cost pressures, there has been decreases in resident learning experiences and intraoperative autonomy compared with previous decades[4-6]. Resultingly, there is concern that graduating surgical residents are less prepared to operate independently on training completion[4,7-9].

Because of societal and legal parameters surrounding modern medicine, it is the duty of the graduate medical education system to ensure optimal care while not sacrificing the production of competent and autonomous surgeons[3]. However, when senior orthopaedic residents were asked in 2011 and 2012 where current education was failing, the most common response was autonomy and ownership of patients[10].

Further complicating an attending surgeon's decision to grant orthopaedic trainees more independence is that assessments of resident competence have historically been knowledge based and do not directly assess intraoperative ability[11-13]. The Ottawa Surgical Competency Operating Room Evaluation (O-SCORE) was created and validated as a surgical assessment tool to objectively evaluate resident competence on any procedure[11]. Although this is the case, studies in other specialties have demonstrated that attendings and residents often have discordant perceptions regarding resident competency and autonomy[2,3,13].

To date, no studies exist evaluating orthopaedic resident intraoperative autonomy and whether increased competency leads to increased autonomy. The purpose of this study was to determine whether there is a difference between resident and attending perception of resident competency and autonomy during arthroscopic rotator cuff repairs and; secondarily, whether increased perceived resident competency by attendings leads to more resident perceived autonomy. We hypothesized that there would be a difference in perception between residents and attendings regarding resident competency and autonomy, and those residents with more perceived competency would be given more perceived autonomy.

Methods

Study Design

After Institutional Review Board determination as exempt status, this study 4was performed over a 12-month academic year from July 1, 2018, to June 30, 2019. Twenty-one orthopaedic residents and 7 orthopaedic attendings from a single institution were included. All subjects involved gave consent to participate.

A survey was developed that included the previously validated O-SCORE[11] along with novel arthroscopic rotator cuff repair specific questions based off 5 key procedural steps predetermined by expert attendings (see Appendix, Table I). Regarding these steps, the survey assessed both the resident's and attending's perception of (1) what percent opportunity the resident was given to complete each step, (2) what percent of each step the resident was able to complete independently without assistance required, and (3) whether the resident could complete the surgery independently. If it was perceived the resident could not complete the surgery independently, the factors that limited autonomy were reported (i.e., technical skill, resident was unprepared, loss of visualization, and taking too much time). Competency-based outcomes included O-SCORE values, percent completed of the key steps, and whether the resident could complete the surgery independently. Autonomy-based outcomes included percent opportunity to complete the key steps.

After each procedure, the case difficulty was determined as simple, moderate, or complex by the operating attending based on predetermined characteristics. The surgery was considered simple if it involved one anchor, one tendon, and no soft-tissue releases for rotator cuff mobilization; moderate for more than one anchor or more than one tendon with no or minimal releases; complex for more than one anchor and more than one tendon and/or a large of amount of releases for repair.

Only arthroscopic rotator cuff repairs that involved a post-graduate year (PGY)-2 to PGY-5 resident were included. Any rotator cuff repair that had an open component was excluded from the analysis. After each surgery, the survey was distributed immediately to the participating resident and attending electronically. Surveys were only included for analysis if completed by both the resident and attending for each procedure.

TABLE I Five Key Procedural Steps During Arthroscopic Rotator Cuff Repairs as Determined by Attending Physicians

A. Trochar insertion + diagnostic arthroscopy
B. Rotator cuff releases and preparation
C. Subacromial space assessment and/or decompression
D. Anchor placement
E. Suture management, passing and tying (if applicable)

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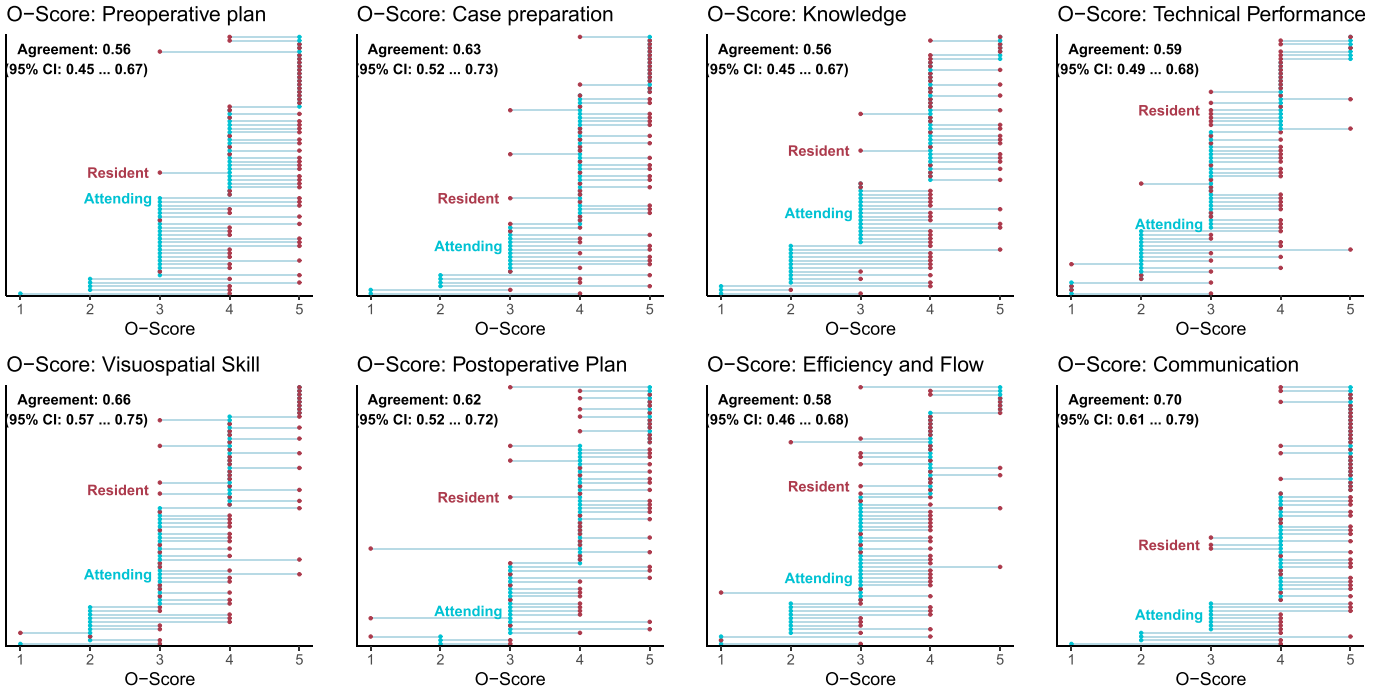

Fig. 1

Dumbbell plots demonstrating the differences in responses between residents and attendings regarding the 8 O-SCORE items. CI = confidence interval, and O-SCORE = Ottawa Surgical Competency Operating Room Evaluation.

Statistical Analysis

An a priori power calculation using mean values from a pilot study to detect a 10-point difference in percent opportunity and percent completion of the key steps between residents and attendings with a standard deviation of 10, 2-sided alpha 0.05, and 80% power yielded a minimum of 90 total surveys (45 procedures). Paired comparisons for binary variables were tested using the McNemar test. Paired comparisons were conducted for continuous variables using the Wilcoxon signed-rank test. Medians were reported for the O-SCORE, given it is a Likert scale. Medians were also reported for continuous values as the responses were non-normally distributed because of a few outliers. Agreement between residents and attendings for the study outcomes was calculated using a linear-weighted Gwet AC_2, given its suitability for dependent measurements[14-16].

A secondary analysis through cross survey associations investigated resident perception of autonomy when stratified by attending perception of competency using Kruskal-Wallis tests. This included a comparison of resident-reported

TABLE II Comparison of O-SCORE Responses Between Attending and Resident Physicians*†‡

	Median Difference (Range) (n = 71)	p-Value	Agreement (95% CI)
O-SCORE (out of 40)	4 (1 to 14)	**<0.01**	0.63 (0.56-0.70)
1. O-SCORE: preoperative plan	1 (0 to 3)	**<0.01**	0.56 (0.45-0.67)
2. O-SCORE: case preparation	0 (0 to 3)	**<0.01**	0.63 (0.52-0.73)
3. O-SCORE: knowledge	1 (−1 to 3)	**<0.01**	0.56 (0.45-0.67)
4. O-SCORE: technical performance	0 (−1 to 3)	**<0.01**	0.59 (0.49-0.68)
5. O-SCORE: visuospatial skill	0 (−1 to 2)	**<0.01**	0.66 (0.57-0.75)
6. O-SCORE: postoperative plan	0 (−3 to 2)	**0.02**	0.62 (0.52-0.72)
7. O-SCORE: efficiency and flow	1 (−2 to 3)	**<0.01**	0.58 (0.46-0.68)
8. O-SCORE: communication	0 (−1 to 3)	**<0.01**	0.70 (0.61-0.79)

*Median differences are calculated using a Wilcoxon signed-rank test. Agreement was calculated using linear-weighed Gwet AC_2. †IQR = interquartile range, and O-SCORE = Ottawa Surgical Competency Operating Room Evaluation. ‡Bold text indicates statistical significance with a p-value <0.05.

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opportunity to complete the key steps to attending-reported O-SCORE, percent completed of the key steps, whether the resident could complete the surgery independently, and PGY-level. Statistical significance was set at $p < 0.05$.

Results

During the study period, the surveys were completed by both the participating resident and attending for 71 of 132 (54%) possible procedures, resulting in a total of 142 surveys (71 residents and 71 attendings). All 21 (100%) of the PGY-2 to PGY-5 residents participated. There were 6 PGY-2, 5 PGY-3, 5 PGY-4, and 5 PGY-5 residents. Forty-three survey (61%) were completed by PGY-2 and PGY-3 residents compared with 28 (39%) by PGY-4 and PGY-5 residents.

Overall Resident Vs. Attending Perceived Competency and Autonomy

Overall, residents reported a 4-point higher median total O-SCORE than attendings with medians of 34 and 30, respectively ($p < 0.01$; agreement = 0.63; Fig. 1, Table II). Although small median differences were seen for individual O-SCORE items, weak-to-moderate levels of agreement between residents and attendings were observed for each item (Fig. 1, Table II)[17].

Residents perceived less opportunity to perform the key steps compared with attendings, with a median opportunity to complete each step of 54% vs. 70%, respectively ($p < 0.01$; agreement = 0.39; Fig. 2, Table III). When looking at each step, strong agreement between resident and attending responses was observed regarding trochar insertion and diagnostic arthroscopy (agreement = 0.80), but minimal-to-weak agreement was seen regarding the other key steps (Table III).

Residents perceived lower percent completed of the key steps compared with attendings, and although these values were more similar with medians of 52% and 61%, respectively, there was minimal agreement between resident and attending responses ($p < 0.01$; agreement = 0.37; Fig. 2, Table III). Regarding individual steps, a significant difference was only seen regarding anchor placement. For this step, although the medians for both the residents and attendings was 50%, given the large variation in responses surrounding the medians, this reached statistical significance ($p < 0.01$; agreement = 0.28; Table III).

Residents believed they could complete the surgery independently 52% of the time compared with 15% by the attendings ($p < 0.01$; agreement = 0.22; Table III). The most common responses of why the resident could not complete the surgery independently between residents and attendings were the lack of technical skill (30% vs. 72%; $p < 0.01$; agreement = 0.07) and taking too much time (30% vs. 30%; $p = 0.17$; agreement = 0.56; Table III).

Junior/Senior Resident Vs. Attending Perceived Competency and Autonomy

When stratifying responses based on the PGY-level, junior and senior residents perceived a median O-SCORE difference compared with attendings of 5 and 2, respectively ($p < 0.01$ and $p < 0.01$; Table IV). Similarly, junior and senior residents perceived lower percent opportunity to complete the key steps compared with attendings, with median differences of 17% and 11%, respectively ($p < 0.01$ and $p < 0.01$; Table IV). Although junior residents perceived a median difference in percent completed of the key steps of 10% less than attendings ($p = 0.02$), there was no significant difference between senior residents and attendings ($p = 0.35$; Table IV). For these outcomes, we observed greater agreement between the senior residents

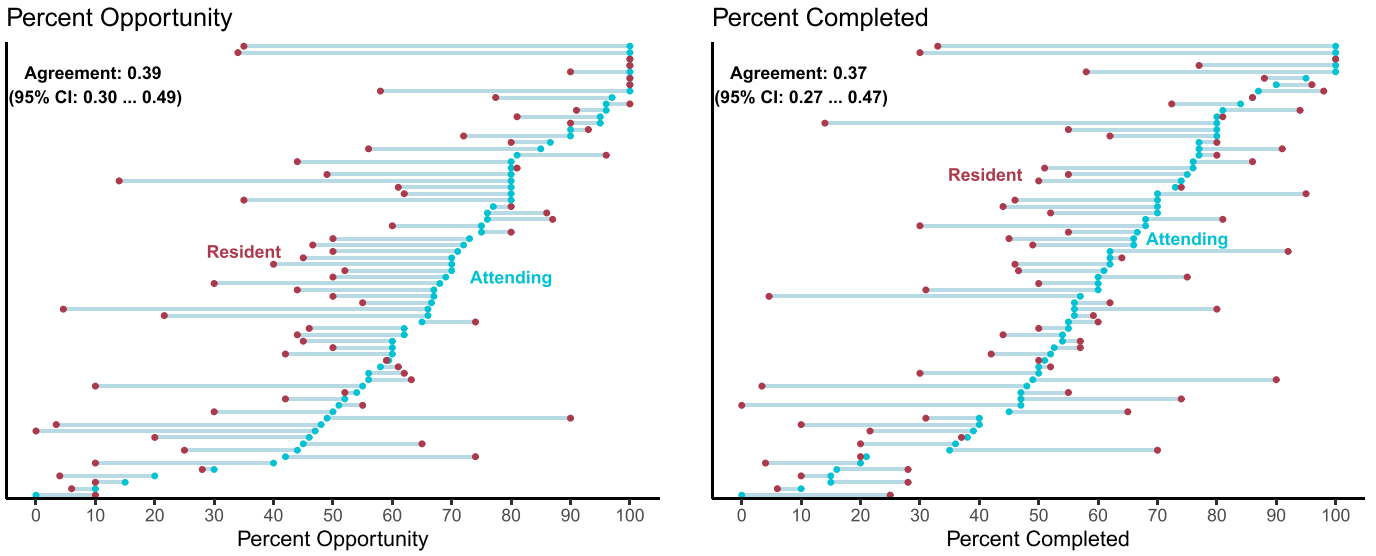

Fig. 2

Dumbbell plots demonstrating the differences in responses between residents and attendings regarding overall percent opportunity and percent competed of the 5 key steps during each arthroscopic rotator cuff repair included in the study. CI = confidence interval.

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TABLE III Comparison of Resident and Attending Responses Regarding Resident Opportunity and Ability to Complete the Predetermined 5 Key Procedural Steps, Whether the Resident Could Complete the Surgery Independently, and If Not, the Reason Why*†‡

	Resident, Median Score (IQR) (n = 71)	Attending, Median Score (IQR) (n = 71)	p-Value	Agreement (95% CI)
Percent opportunity (overall)	54 (35-79)	70 (55-81)	**<0.01**	0.39 (0.30 to 0.49)
Step A	100 (75-100)	100 (100-100)	**<0.01**	0.80 (0.70 to 0.91)
Step B	40 (0-95)	75 (25-100)	**<0.01**	0.35 (0.19 to 0.52)
Step C	70 (25-90)	80 (50-100)	**<0.01**	0.38 (0.21 to 0.55)
Step D	25 (0-75)	70 (25-100)	**<0.01**	0.34 (0.18 to 0.49)
Step E	50 (25-75)	50 (25-100)	**0.04**	0.42 (0.29 to 0.55)
Percent completed (overall)	52 (31-75)	61 (49-77)	**0.02**	0.37 (0.27 to 0.47)
Step A	100 (50-100)	100 (78-100)	0.90	0.72 (0.59 to 0.84)
Step B	50 (0-80)	50 (25-100)	0.10	0.36 (0.21 to 0.51)
Step C	50 (25-90)	60 (50-95)	0.11	0.36 (0.21 to 0.51)
Step D	50 (0-75)	50 (25-95)	**<0.01**	0.28 (0.13 to 0.43)
Step E	50 (28-75)	50 (25-80)	0.91	0.39 (0.25 to 0.53)
Could the resident complete the surgery independently, yes, % (n)	52 (37)	15 (11)	**<0.01**	0.22 (−0.03 to 0.47)
Reason resident could not complete the surgery independently				
Lack of technical skills, % (n)	30 (21)	72 (51)	**<0.01**	0.07 (−0.16 to 0.30)
Lack of visualization, % (n)	11 (8)	14 (11)	0.61	0.71 (0.55 to 0.86)
Taking too much time, % (n)	30 (21)	30 (21)	0.17	0.56 (0.36 to 0.77)

*Median values for continuous variables were compared through a Wilcoxon signed-rank test. Agreement was calculated using linear-weighed Gwet AC_2. Questions of whether the resident could complete the surgery independently and reason they could not complete the surgery independently are reported as counts and proportions and compared in pairs using a McNemar test. Step A: Trocar insertion + diagnostic arthroscopy; Step B: Rotator cuff releases and preparation; Step C: Subacromial space assessment and/or decompression; Step D: Anchor placement; Step E: Suture management, passing, tying. †CI = confidence interval, IQR = interquartile range, Avg = average. ‡Bold text indicates statistical significance with a p-value <0.05.

and attendings compared with the junior residents and attendings (Table IV).

When evaluating perception of whether the resident could complete the surgery independently, both junior and senior residents believed that they could complete the surgery more frequently compared with attendings, with differences of 28% and 50%, respectively ($p < 0.01$ and $p < 0.01$; Table V). When residents were not able to complete the surgery independently, junior and senior residents perceived that this was less frequently because of the lack of technical skill compared with attendings, with differences of 42% and 43%, respectively ($p < 0.01$ and $p < 0.01$; Table V). In addition, when senior residents could not complete the surgery independently, they most frequently perceived that this was because of taking too much time, although attendings perceived that this was because of the lack of technical skill (Table V).

Resident Perception Based on Case Complexity

When evaluating resident perception based on case complexity, residents believed that they were given more opportunity the simpler a case was, with medians of 61%, 52%, and 35% for simple, moderate, and complex cases, respectively ($p = 0.03$; Table VI). No significant difference was seen regarding resident perception of percent completed of the key steps based on case complexity, with medians of 55%, 52%, and 50% for simple, moderate, and complex cases, respectively ($p = 0.20$; Table VI). Residents did not have a significant difference in perception of whether they could complete the surgery independently based on case complexity, with residents perceiving they could complete 55%, 57%, and 40% for the simple, moderate, and complex cases, respectively ($p = 0.53$; Table VI).

Resident Perceived Autonomy Associated with Attending Perceived Competency

In secondary analysis, resident perceived opportunity to complete the key steps increased with higher attending-reported O-SCOREs and percent completion of the key steps ($p < 0.01$; Table VII). Increased perceived opportunity was observed with the PGY-level, with junior and senior residents

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TABLE IV Difference in Resident and Attending Responses Regarding O-SCORE, Percent Opportunity and Percent Completed of the 5 Key Procedural Steps When Stratified Between Junior and Senior Residents*†‡

	Strata	Resident Median (IQR)	Attending (IQR)	Median Difference (Resident to Attending)	p-Value	Agreement (95% CI)
O-SCORE						
PGY	2-3	33 (31-36)	28 (23-31)	5 (2 to 10)	**<0.01**	0.55 (0.45-0.64)
	4-5	34 (32-37)	32 (28-36)	2 (0 to 5)	**<0.01**	0.77 (0.70-0.84)
Overall percent opportunity						
PGY	2-3	50 (35-69)	67 (56-80)	−17 (−27 to 1)	**<0.01**	0.31 (0.16-0.47)
	4-5	59 (35-69)	70 (54-91)	−11 (−20 to 0)	**<0.01**	0.56 (0.42-0.71)
Overall percent completed						
PGY	2-3	50 (30-66)	60 (49-73)	−10 (−23 to 5)	**0.02**	0.38 (0.23-0.53)
	4-5	61 (42-81)	68 (47-77)	−7 (−19 to 7)	0.35	0.53 (0.40-0.66)

*Negative values represent that residents had a lower median difference compared to attendings (i.e., for percent opportunity, a value of −17 represents the resident perceived 17% less opportunity to complete the 5 key procedural steps compared to the attendings). Agreement was calculated using linear-weighed Gwet's AC_2. †CI = confidence interval, IQR = interquartile ranges, and O-SCORE = Ottawa Surgical Competency Operating Room Evaluation. ‡Bold text indicates statistical significance with a p-value <0.05.

perceiving medians of 50% and 60%, respectively; however, this did not reach statistical significance (p = 0.35; Table VII). No significant difference was observed with resident opportunity and attending-reported ability to complete the surgery independently (p = 0.71; Table VII).

Discussion

A growing concern in current medical education is a lack of trainee autonomy during operative procedures[1,3,4,10,18-22]. Previously, a discordance has been demonstrated in certain disciplines between residents and attendings regarding resident

TABLE V Difference in Resident and Attending Responses Regarding Whether the Resident Could Complete the Surgery Independently, and If Not, the Reason Why When Stratified Between Junior and Senior Residents*†‡

	Strata	Resident, % (n)	Attending, % (n)	Difference (Resident- Attending), % (n)	p-Value	Agreement (95% CI)
Could the resident complete the surgery independently, yes						
PGY	2-3	40 (17)	12 (5)	28 (12)	**<0.01**	0.38 (0.07 to 0.69)
	4-5	71 (20)	21 (6)	50 (14)	**<0.01**	0.01 (−0.39 to 0.40)
Reasons the resident could not complete the surgery independently						
Lack of technical skills						
PGY	2-3	42 (18)	84 (36)	−42 (−18)	**<0.01**	0.18 (−0.15 to 0.51)
	4-5	11 (3)	54 (15)	−43 (−12)	**<0.01**	0.11 (−0.32 to 0.55)
Lack of visualization						
PGY	2-3	16 (7)	7 (3)	9 (4)	0.21	0.71 (0.51 to 0.91)
	4-5	4 (1)	25 (7)	−21 (−6)	0.34	0.72 (0.46 to 0.97)
Taking too much time						
PGY	2-3	14 (6)	28 (12)	−14 (−6)	0.08	0.72 (0.52 to 0.93)
	4-5	32 (9)	36 (10)	−4 (−1)	0.76	0.29 (−0.11 to 0.68)

*Negative values represent that residents believed the given factor limited autonomy less frequently compared with attendings (i.e., PGY 2 to 3 residents believed they could not complete the surgery independently because of the lack of technical skill 42% less of the time compared to attendings). Agreement was calculated using linear-weighed Gwet AC_2. †CI = confidence interval. ‡Bold text indicates statistical significance with a p-value <0.05.

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TABLE VI Comparison of Resident Responses Between Different Strata of Case Complexity Regarding Opportunity and Ability to Complete the 5 Key Procedural Steps and Whether the Resident Could Complete the Surgery Independently*†

	Strata	Median Resident Opportunity (IQR)	p-Value
Complexity	Simple	61 (44-81)	**0.03**
	Moderate	52 (33-68)	
	Complex	35 (10-59)	
		Median Resident Completed (IQR)	p-Value
Complexity	Simple	55 (44-80)	0.20
	Moderate	52 (32-73)	
	Complex	50 (16-61)	
		Independently Completed by Resident, n (%)	p-Value
Complexity	Simple	18/33 (55)	0.53
	Moderate	13/23 (57)	
	Complex	6/15 (40)	

*IQR = interquartile range. †Bold text indicates statistical significance with a p-value <0.05.

TABLE VII Difference in Resident Perceived Opportunity Between Different Strata of Attending Responses and PGY-Level Using the Kruskal-Wallis Tests*†

	Strata	Median Resident Opportunity (IQR)	p-Value
O-SCORE (attending)	0-20	23 (16-33)	**<0.01**
	21-30	52 (44-65)	
	31-40	62 (43-89)	
Percent completed (attending)	0-50	28 (10-52)	**<0.01**
	51-75	50 (44-61)	
	76-100	87 (62-97)	
Could the resident complete the surgery independently? (attending)	No	52 (30-78)	0.71
	Yes	49 (41-74)	
PGY-level	2-3	50 (35-69)	0.35
	4-5	60 (38-82)	

*IQR = interquartile ranges, and O-SCORE = Ottawa Surgical Competency Operating Room Evaluation. †Bold text indicates statistical significance with a p-value <0.05.

competency and autonomy[2,6,13,20,21,23]. The purpose of this study was to determine whether a difference in perception exists between orthopaedic residents and attendings regarding competency and autonomy during arthroscopic rotator cuff repairs and if increased perceived competency leads to increased autonomy. A difference was demonstrated between resident and attending perception of competency and autonomy, and those residents with higher perceived competency via the O-SCORE and percent completed of the key steps were granted more autonomy. Increased autonomy was not dependent on the PGY-level.

The ultimate goal of surgical education was to produce safe surgeons ready for independent care on completion[3]. Critical to resident development is performing procedures with graduated autonomy[24]. It is important for residents to perceive that they are obtaining appropriate autonomy, so they can develop confidence necessary to transition into practice[3]. Since the advent of the 80-hour work week, surgical residents report a lack of readiness for practice on training completion[3,7,25]. In a survey to 55 general surgery programs, 23% of graduates were not confident their training prepared them for practice[25].

In our study, orthopaedic attendings perceived that they were allowing more intraoperative autonomy compared with residents with median percent opportunity to complete the key steps of 70% and 54%, respectively. Senior residents perceived opportunity more closely resembled attendings, but there still was a median difference of 11%, and only weak agreement. As senior residents have more experience to accurately assess their involvement intraoperatively, this difference is significant. Improving resident and faculty congruence on autonomy provided is imperative for the development and assessment of resident preparedness to practice independently.

In order for orthopaedic attendings to better promote resident autonomy, it is critical that they can accurately assess resident competence to allow safe entrustment[9,26-28]. Several general surgery studies enumerate common factors affecting faculty entrustment: resident competence, resident familiarity, PGY-level, and attending experience[18,19,27,29,30]. Given attending perception of resident competence is subjective and susceptible to bias based on resident familiarity and PGY-level, it is important that more objective measures of competence in orthopaedics are implemented[11,26,31].

In this study, through objective measures, differences in resident and attending perception of competence were observed. Although attendings perceived lower resident competence based on O-SCOREs and less frequent ability to complete the surgery independently, they reported a higher percent completion of the key steps. Conversely, although residents believed that they completed less of the key steps, they more frequently believed that they could complete the surgery independently. These differences largely persisted even when stratifying between junior and senior residents.

Although the differences in perception of competence observed were similar to results seen in general surgery[8,18,19,29,30], interestingly, when orthopaedic attendings perceived residents to be more competent, residents perceived more autonomy. As residents enter training with differing baselines of surgical acumen, the education model of "better" residents participating more intraoperatively portends to a continuously growing gap in experience and ability between residents who are perceived to be

more vs. less competent. By having residents who are perceived to be less competent scrub into more cases but allow limited intraoperative participation, it is likely that marginal improvements are obtained. Conversely, it is possible that residents who are not ready for safe entrustment would benefit more from increased practice time outside the operating room to develop necessary abilities.

In the secondary analysis, it also must be noted that there was not a statistically significant difference in resident perceived autonomy based on the PGY-level. One possible explanation for this is that 80% of senior residents included were pursuing subspecialties not involving rotator cuff repairs. In addition, at this institution, the educational curriculum was changed 2 years before the study, where junior residents currently have substantial increases in exposure to rotator cuff repairs that the senior residents did not have. As a result, the senior residents likely have dedicated less educational time performing this procedure. Furthermore, given the curriculum, our study included a higher proportion of surveys completed by junior residents that may have influenced these results. In addition, given this is a secondary analysis, it is likely that our study was underpowered to detect these differences.

A potential limitation of this study was that it was performed at a single institution and may not be generalizable to other programs. We chose to focus on a single procedure that has a wide range of case complexity and is routinely performed by PGY-2 through PGY-5 residents at our institution; however, comparisons to potentially less complicated arthroscopic procedures, such as a partial meniscectomy, would be beneficial in future studies. Furthermore, being participants were knowingly observed, the results are subject to the Hawthorne effect. In addition, although the survey was limited in that it was administered to the same residents and attendings on multiple occasions, bias inherent to the participants was mitigated by utilizing Wilcoxon signed-rank tests, which by ranking outcomes to assess nonparametric differences and minimizes the impact of similar reporting by individual residents or attendings. Another potential weakness is the wording of the survey options. It is likely that given enough time, most residents would be able to independently complete the case. In this study, time allowed was based on attending discretion, and there were likely instances where attendings took over, regardless of resident performance because of external pressures. Nevertheless, it is the duty of the attending to ensure optimal care, and arthroscopic rotator cuff repair is a procedure that becomes more technically demanding with prolonged time because of shoulder swelling. Surgeon efficiency is a key parameter of independent case completion from the perspective of the attendings in this study. However, residents may not share this perspective, which is likely another difference in perception.

Despite these limitations, this study is the first in orthopaedic literature to demonstrate differences in resident and attending perception regarding intraoperative competency and autonomy and that perceived competency leads to increased perceived autonomy. In addition, it implemented a novel, objective, procedure-specific measure to assess procedural competency. Future research should evaluate differences in resident and attending perception across multiple orthopaedic programs and investigate whether increased practice outside the operating room leads to increased competency and autonomy intraoperatively.

Appendix

eA A data supplement is available with the online version of this article at jbjs.org (http://links.lww.com/JBJSOA/A211) ■

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