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The Supervisor's Toolkit: Strategies of Supervisors to Entrust and Regulate Autonomy of Residents in the Operating Room

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Objective: To identify what strategies supervisors use to entrust autonomy during surgical procedures and to clarify the consequences of each strategy for a resident's level of autonomy.

Background: Entrusting autonomy is at the core of teaching and learning surgical procedures. The better the level of autonomy matches the learning needs of residents, the steeper their learning curves. However, entrusting too much autonomy endangers patient outcome, while entrusting too little autonomy results in expertise gaps at the end of training. Understanding how supervisors regulate autonomy during surgical procedures is essential to improve intraoperative learning without compromising patient outcome.

Methods: In an observational study, all the verbal and nonverbal interactions of 6 different supervisors and residents were captured by cameras. Using the iterative inductive process of conversational analysis, each supervisor initiative to guide the resident was identified, categorized, and analyzed to determine how supervisors affect autonomy of residents.

Results: In the end, all the 475 behaviors of supervisors to regulate autonomy in this study could be classified into 4 categories and nine strategies: I) Evaluate the progress of the procedure: inspection (1), request for information (2), and expressing their expert opinion (3); II) Influence decision-making: explore (4), suggest (5), or declare the next decision (6); III) Influence the manual ongoing action: adjust (7), or stop the resident's manual activity (8); IV) take over (9).

Conclusions: This study provides new insights into how supervisors regulate autonomy in the operating room. This insight is useful toward analyzing whether supervisors meet learning needs of residents as effectively as possible.

Keywords: autonomy, entrustment, intraoperative teaching, teach the teacher (*Ann Surg* 2020;xx:xxx–xxx)

In the daily practice of teaching hospitals, supervisors are regularly confronted with the question: “How much autonomy can I entrust this resident for this patient at this particular moment?” Both supervisors and residents agree that entrusting progressive autonomy without compromising patient outcome is one of the most important objectives of learning and teaching in the operating room (OR).^{1–6} Moreover, entrusting residents with the best possible level of

autonomy acts as a double-edged sword: it preserves a high standard of patient care as it maximizes residents' learning.

In the operating room, residents are usually allowed to proceed autonomously until supervisors foresee that outcome or time schedules will be compromised.⁷ Supervisors therefore need to continuously estimate what level of autonomy can be entrusted to residents. Problems arise when supervisors make inaccurate assessments of residents' abilities or experience;^{8,9} allowing residents too much autonomy may endanger patient outcome, whereas restricting their autonomy slows down learning curves, may cause gaps in expertise at the end of training, and could be demotivating.^{7,10–12} As patient outcome is always the primary consideration, supervisors specifically tend to restrict autonomy in critical situations – unfortunately, it is precisely at those moments that residents need autonomy to master such critical tasks.^{7,8,12–17}

Managing the autonomy of residents during patient encounters has been studied from different angles. Review studies have demonstrated that supervisors are more willing to hand over autonomy when they trust the resident and when supervisors are familiar with the procedure themselves.^{18–20} Supervisors tend to entrust more autonomy to the resident when they experience a positive working relationship, increases the level of autonomy. However, incongruent personalities decrease levels of entrusted autonomy.^{18–21} In addition, supervisors stressed how they constantly adjust and negotiate control over the procedure, but emphasize the need to always stay in control of the residents.^{7,14} Once in the OR, residents experience that levels of autonomy vary within a procedure and between supervisors, even when the supervisors share principles about residents' safety and competence.^{20–22}

Although former research clearly demonstrates that supervisors do regulate autonomy continuously, the question how supervisors exactly regulate autonomy in the real time of a surgical procedure remains unanswered. Once autonomy-regulating strategies of supervisors are identified and understood, both supervisors and residents will be able to analyze explicitly whether levels of entrusted autonomy match a resident's needs effectively. This information can help supervisors optimize the level of entrustment in forthcoming procedures, thereby accelerating residents' learning curves without compromising patient outcome.

The objective of this study is to identify the specific strategies that supervisors use to regulate residents' autonomy in the OR. To this end, we conducted an observational study and analyzed all the linguistic and nonverbal behaviors that 6 supervisors displayed to influence residents' autonomy during 1 single surgical procedure. We subsequently classified these behaviors into categories, according to the function they have for the supervisor and the effects they attain at the levels of a resident's autonomy.

METHODS

Setting and Participants

The study was conducted from 2016 to 2019 at University Medical Center Groningen in the Netherlands. We selected an

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The authors conducted a qualitative observational study of real-time supervisors' behaviors guiding residents in the operating room.

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TABLE 1. Six Dyads and Their Characteristics

Dyad	Supervisor	Sex	Resident-PY*	Gender	Duration (h/min/s)
1	A =Orthopedic surgeon	Male	Orthopedics PY 2	Female	36 min/07 s [†]
2	B =Orthopedic surgeon	Male	Orthopedics PY 5	Male	1 h/33 min/07 s
3	C= Fellow in orthopedic surgery	Female	Orthopedics PY 4	Male	1 h/26 min/04 s
4	D= PY 6* Resident in orthopedics	Male	Orthopedics PY 5	Male	1 h/01 min/25 s
5	E= Physician assistant	Male	Orthopedics PY 4	Male	1 h/03 min/55 s
6	F= Physician assistant	Male	Orthopedics PY 6	Male	58 m/38 s

*PY indicates program year.

[†]Supervisor took over procedure.

uncemented total hip replacement because residents have to be able to execute this procedure safely and without direct supervision at the end of their training. Furthermore, the procedure is highly protocolized in our institution, and has a number of steps of which some carry substantial risks for the patient. The orthopedic surgeons at our institution have different supervisor positions: they themselves provide supervision in the OR, or delegate supervision to either fellows (recently licensed orthopedic surgeons), senior residents or physician assistants (Physician assistants are operating room assistants that are specialized in hip replacement surgery). The residents in this study did their rotation at the university medical center. In the Netherlands the training program for orthopedic surgery comprises 6 years. Residents start their training in general surgery and acute care in PY1 and half of PY2. Then they are trained in orthopedics and have rotations in the university hospital and 1 to 2 other teaching hospitals.

In this study we took a convenience sample of our daily practice (Table 1). The procedures were attended by 6 different supervisors: 2 orthopedic surgeons, 1 fellow, 1 senior resident (program year 6), and 2 physician assistants. Physician assistants and senior residents can only be scheduled as supervisors after consent of the faculty. Each of the supervisors worked with a different resident in orthopedic surgery (ranging from PY2 to program year 6), and all the participating residents were entrusted with the scalpel from the start of the procedure.

Before the start of the procedure, supervisors, residents, patients, and OR personnel were informed about the goal of the study and written consent was obtained. The ethical review board of University Medical Center Groningen discussed the study and confirmed that the Medical Research Involving Human Subjects Act (WMO) did not apply.²³ We followed the Helsinki declaration of medical research for all participants in this study.²⁴

Data Collection and Analysis

Data was collected from 2016 to 2017. We recorded video and audio of supervisors and residents with 3 wide-angle cameras from 3 different observation angles in the OR. Conversation analytic methods were used to transcribe, describe, analyze, and understand all verbal and nonverbal interactions between supervisors and residents. Conversation analysis (CA) originated within sociology in the 1960s.²⁵ The fundament of CA is that interactions embody information about the participants goals and how they want to accomplish these goals. The focus of CA is on the procedures that participants use to structure and organize their interactions, ranging from turn-taking (who has the right to speak), turn-design (how do speakers shape their contributions), sequence organization (how do utterances relate to each other), and repair organization (how do participants deal with problems in speaking, hearing, and understanding).²⁶ Conversation analysis is used to analyze both everyday interactions and institutional interactions, including substantial work in medical settings.^{27,28} Verbal interactions in CA are commonly transcribed using the Jeffersonian Transcription System.^{29,30} However, in the text

we present these transcripts in simplified form to facilitate readers unfamiliar with the conventions of that transcription system.

After recording and transcription, we included all the verbal and nonverbal interactions of supervisors that guide the resident. We then excluded all utterances that were responsive to utterances of the resident (second pair parts) and focused on initiating actions by the supervisor (first pair parts).^{25,31} We then analyzed these verbal and nonverbal interactions of supervisors based on their linguistic format. In the subsequent iterative inductive process we specified categories based on interactional function. In this process, nonverbal properties of the interaction were also included in the analysis. The results were discussed in the research group and categories were altered, added, or rejected. These refined categories were then retested in all the data until saturation was achieved.

RESULTS

Strategies of Supervisors to Regulate Autonomy

From the dataset, we identified a total of 475 guiding behaviors leading to 9 explicit overarching guiding strategies that supervisors used to regulate residents' level of autonomy. The strategies could be further classified into 4 categories, as supervisors use strategies to I) *evaluate* the progress of the procedure and thus verify the effect of the activities of the residents, II) insert themselves in the *decision-making* process of the residents, III) influence the *ongoing manual actions* of the residents, or IV) *take over* all activities.

As a group, supervisors initiated behaviors to evaluate the progress of the procedure and decision-making at respectively 260 (55%) and 142 (30%) instants. At 50 (10%) instants supervisors used strategies to influence the ongoing manual activities of residents and in 23 (5%) instants they took over the procedure partially or totally.

Below we present for each category a general introduction, the frequencies, and the prototypical examples of each of the 9 strategies, before elaborating on the effect each strategy has on the autonomy of the resident.

Category I: The supervisor evaluates the progress of the procedure

"I want to be sure before you continue"

Thorough evaluation of the progress of the procedure is a prerequisite of decision-making. Supervisors use 3 evaluating strategies: inspect, request for information, and giving an expert opinion (Table 2). Two of the strategies in this category (inspecting and requesting information) are specifically concerned with the collection of additional information about the progress of the procedure. In addition supervisors also share expert opinions about the patient with the resident throughout the procedure.

Inspect the Progress of the Procedure

To inspect the progress of the procedure, supervisors showed 2 nonverbal strategies: "zooming in" and "physical examination" (Table 1). During the procedure the residents have optimal visual

TABLE 2. Evaluate the Progress of the Procedure: Type, Frequency, and Prototypical Examples

1. Inspect	Frequency n = 137
Prototypical example: zoom in	Supervisor F + resident (PY6); 11 min:11 sec into the case The supervisor moves his body forward to the side of the resident. The resident reacts by moving his head and body backwards. The supervisor creates a new angle of observation that is facilitated by the resident. After looking into the wound the supervisor retreats without any comment. The resident continues to operate.
Prototypical example: physical examination	Supervisor E + resident (PY5); 21 min:10 sec into the case The resident just osteomized the collum femoris and removes the femoral head. Instantly the supervisor puts his hand on the wound and examines the level of the osteotomy. The resident waits for the supervisor. The supervisor gives no comment and the resident continues.
2. Request for information	Frequency n = 31
Prototypical example:	Supervisor E + resident (PY5); 53 min:22 sec into the case The resident inserts the cup prosthesis. The supervisor, who lacks the tactile information of the resident, inquires: "Is it fixed properly?" The resident confirms.
3. Expert opinion	Frequency n = 92
Prototypical example:	Supervisor D + resident (PY5); 46 min:30 sec into the case The resident is testing the prosthesis. They both look at the surgical wound. The supervisor comments: "It is all looking a bit tight." The resident reacts confirmatively and continues to operate.
Total	Frequency n = 260

and manual access to the operating field. Supervisors, however, have limited access to oversee the operating field from their position at the opposite side of the operating table. Furthermore, supervisors are excluded the tactile information of the residents when they operate. When supervisors zoom in, they change their body position in such a way that they achieve a better angle of observation. In reaction to supervisors' actions, residents often change their body position or retract their hands to facilitate the supervisors. Usually, supervisors reposition themselves without any comments or evaluations and residents continue to operate. These nonverbal behaviors make the role of supervisors observable and explicit.

When "palpating," supervisors not only do a visual inspection, they also examine the wound physically. Residents always accommodate supervisors' physical examination of the wound; they pause their activities and/or remove instruments out of the surgical field. In claiming access to the surgical field, this strategy is more intrusive than zooming in. Inspections by supervisors affect the autonomy of residents only temporarily. Residents have to stop, allow the supervisors to finish and await the supervisors' reaction. When supervisors do not provide information about their inspection, their silence is invariably treated by the residents as tacit consent to continue.

Request Information About the Current Status of the Procedure

By zooming in and physically examining the wound, supervisors unilaterally collect additional information. Supervisors can also request information about the current status of the operation from the resident. Residents always respond to such requests. Although this strategy functions as a request for information about the procedure, such requests can also be interpreted as an implicit tool to assess a resident's proficiency to provide adequate information. Note that an evaluation is not provided by the supervisors, they just inquire and leave the final evaluation to the resident.

Provide an Expert Opinion

In this strategy, supervisors do provide an expert evaluation or assessment of the procedure. Nonverbal inspection strategies regularly precede such expert opinions of supervisors, which are end-points of processing information about what residents accomplish. The residents mostly do not respond to these expert opinions. Presenting an expert opinion affects the resident's autonomy in assessing and evaluating progress of the procedure. Each unrequested

expert opinion by the supervisor takes away the option for the resident to evaluate and assess their progress independently. By giving an expert opinion about the current status of the procedure without any follow-up strategy, supervisors give implicit consent that the accomplishments of the residents were sufficient, and that they may continue: an expert opinion also functions as an implicit assessment of the residents.

Category II: The supervisor manages the decision-making of the resident

"I want to be sure how you proceed"

Supervisors also involve themselves in residents' decision-making. Supervisors use 3 strategies to manage decision making; exploring the next decision, suggesting the next decision, and declaring the next decision (Table 3). With these strategies supervisors influence decision-making proactively. Supervisors can be more or less directive in their involvement in decision making, thus regulating the level of autonomy of the resident. Supervisor and resident can explore the next decision together, and the supervisor can suggest a next decision based on expertise, or the supervisor can declare the next decision.

Explore the Next Decision of the Resident

With this strategy supervisors entrust residents to formulate a decision independently at first, but then insert themselves into the decision-making process. With this strategy supervisors request residents to share their thoughts about the upcoming decision, and in doing so turn residents' otherwise tacit and implicit decision-making into an explicit and therefore controllable process. Although the supervisor just explores the next step of the procedure, for residents this may serve as a pretest before they are allowed to continue.

Suggest the Next Decision to the Resident

With this strategy supervisors not only ask a resident to explicitly state the next step, but actually take the initiative in the decision-making process. With a suggestion, supervisors provide an expert decision while still allowing room for an alternative decision. In doing so, supervisors and residents share the autonomy of decision-making. Of course, the suggestion can also formulate a plan that a resident was already committed to; in these cases such suggestions of the supervisors serve as an unrequested confirmation to the residents. In any event, a suggestion restricts residents' independent decision-making.

TABLE 3. Manage the Decision-making of the Resident: Type, Frequency, and Prototypical Examples

1. Explore the next decision Prototypical example:	Frequency n = 16 Supervisor D + resident (PY5); 43 min:06 sec into the case The resident is in the process of preparing the femur with reamers. He just finished a ream action and then the supervisor explores: "Shall we go proximal? Or do you want to try the seven." The resident responds that he is satisfied with the result and wishes to continue.
2. Suggest the next decision Prototypical example:	Frequency n = 55 Supervisor E + resident (PY4); 34 min:42 sec into the case The resident just removed the reamer out of the acetabulum. The supervisor suggests: "What might be a possible option is to ream the entrance of the acetabulum with a 53." The resident does not take over the suggestion of the supervisor.
3. Declare the next decision Prototypical example:	Frequency n = 71 Supervisor E + resident (PY4); 32 min:56 sec into the case The resident inserts the cup prosthesis. He stops hammering on the inserter and looks into the wound. The supervisor says: "Insert cup a little deeper". The resident continues without any reaction and hammers the cup deeper into the acetabulum. The resident is testing the prosthesis. They both look at the surgical wound. The supervisor comments: "It is all looking a bit tight." The resident reacts confirmatively and continues to operate.
Total	Frequency n = 142

Declare the Next Activity

In the former strategy, decision-making is a shared process; in the last strategy of this category supervisors declare the next activity to the residents, thus unilaterally decide how the procedure should continue. Declaring a decision functions as an instruction and is regularly observed as a follow-up after supervisors assess or evaluate the current status of the procedure. Again, the resident may have decided to continue per the supervisor's instruction. In that case the decision serves as an unrequested confirmation, as explained before. However, in the end of training surgical trainees should be able to proceed without confirmation from experts.

Category III: The supervisor adjusts the ongoing manual activity of the residents

"I want you to proceed as I would"

Supervisors not only partake in evaluation and decision-making, they also intervene in the manual actions of residents. To this end, supervisors use 2 strategies: adjusting the ongoing action and stopping the ongoing action (Table 4).

Adjust the Ongoing Activity of the Residents

In this category the supervisor explicitly and instantaneously tries to direct the course of the resident's ongoing manual activity (either verbally or nonverbally). In the nonverbal variants the supervisor usually repositions or adjusts the resident's hand. Nonverbal adjustments are often accompanied by a verbal account or explanation. Supervisors do not introduce, discuss, or negotiate their upgrade in guidance. Residents invariably adapt to their supervisors' adjustments.

Stop the Ongoing Activity of the Residents

In more extreme cases the supervisor stops the activity of the resident altogether. This strategy functions as an emergency brake. In some cases the supervisor cannot foresee a resident's course of action and needs to stop and evaluate the current situation. In other cases the supervisor is able to estimate the course of the resident's hand and interrupt the ongoing action before patient outcome is affected. When supervisors pull this emergency brake, they overrule residents in the most explicit manner; residents are corrected and have to wait and see what level of entrustment will be granted by the supervisor before they may continue.

Category IV: The supervisor overtakes all activities of the residents

"I will handle the scalpel"

Take over activities of residents in the same manner as the previous 8 strategies written in bold and a larger font. (take over is the 9th strategy of the toolkit).

Supervisors can also take over all decision-making, manual activities, and evaluations (Table 5). In this study, all supervisors took over minor parts of the procedure. They regularly just asked the scrub nurses for an instrument and started to remove tissue to improve exposure. A step up was taking over a major part of the procedure before handing back the scalpel to the resident. Only once did a supervisor take over the complete procedure.

In all cases—small parts, steps or taking over completely—the residents were no longer entrusted autonomous evaluation, decision-making, and task execution. The supervisors took over and the residents were obliged to assist the supervisor instead of operating themselves.

TABLE 4. Manage the Ongoing Manual Activity of the Resident: Type, Frequency, and Prototypical Examples

1. Adjust the ongoing activity Prototypical example: a. Verbally	Frequency n = 46 Supervisor A + resident (PY2); 12 min:55 sec into the case While the resident is dissecting with the scalpel the supervisor utters: "Keep going to the dorsal side, don't go to the ventral side."
Prototypical example: b. Nonverbally	Supervisor B + resident (PY5); 1 h:05 min:30 s into the case The resident is inserting a reamer in the femur and about to start. The supervisor takes his hand and without commenting repositions the hand on the instrument. Then the resident continues to operate.
2. Stop the ongoing activity Prototypical example:	Frequency n = 4 Supervisor C + resident (PY4); 1 h:12 min:36 s into the case The resident inserts the definitive stem into the femur. While doing this, the supervisor utters: "Stop now". The resident stops immediately and the supervisor looks into the wound. The resident asks if anything is wrong.
Total	Frequency n = 50

TABLE 5. Take Over the Activity of the Resident: Type, Frequency, and Prototypical Examples

1. Take over	Frequency n = 23
Prototypical example:	Supervisor A + resident (PY2); 45 min:15 sec into the case The resident has been struggling for some time and asks for help continuously. Then the supervisor states: "I will proceed myself," and starts to walk to the position of the resident. The resident steps back and walks to the other side of the operating table to assist the supervisor.
Total	Frequency n = 23

The Supervisor as Overseer: Implicit Surveillance

In addition to the 9 explicit verbal strategies, supervisors also implicitly survey the resident. When a supervisor just assists the resident, there is no explicit behavior indicating whether they are acting as constant overseers and overhearers of all elements of the procedure. However, our data provide indirect evidence that both supervisors and residents orient to this facet of supervision. Box 1 gives an example, where this orientation is stated explicitly (line 4).

Box 1 Supervisor A Guiding a Resident PY 2, 16 min:10 s Into the Case

Line 1		6.2 s of silence
Line 2	Supervisor A	At first, you have to create a clear view yourself
Line 3		0.7 s of silence
Line 4	Supervisor A	To be honest, I cannot see what you are doing at all
Line 5		1.8 s of silence

The supervisor asks the scrub nurse for 2 self-retractors after the resident incised the fascia of the musculus tensor fascia latae. While placing the retractors in the wound to obtain a better exposure, the supervisor verbalizes an account for his action (lines 2 and 4). During this episode the resident was holding a forceps and waited until the supervisor completed his action. Then the resident continues to operate.

In Box 2 we see a similar orientation to the need for supervisor A to monitor, this time coming from the resident (line 2). Here, the resident explores whether supervisor A is able to see the resident's actions.

Box 2 Supervisor A Guiding a Resident PY 2, 25 min:08 s Into the Case

Line 1		31.0 s of silence
Line 2	Resident PY 2	Are you able to see what I'm doing from your view or not?
Line 3	Supervisor A	Yes
Line 4		3.7 s of silence

The resident was incising the tissue, then checks whether the supervisor was still able to see the results of the incision (line 2). The supervisor confirms that there is oversight (line 3). The resident continues with the procedure.

As a result, the supervisor's lack of initiative to interfere is not neutral but an implicit stamp of approval of the resident's actions because of the presumed, constant implicit monitoring of the procedure.^{20,27} The supervisor's silence is treated as tacit consent for the resident to continue, being entrusted by the supervisor with the maximum level of autonomy.

DISCUSSION

Regulation of Autonomy

This study identified 9 strategies (both verbal and nonverbal) that supervisors use to entrust autonomy to residents in the operating room. In the end, these strategies were classified into 4 categories. Supervisors use strategies to: I) inform themselves about the progress of the procedure; II) influence residents' decision-making; III) adjust or redirect the ongoing manual activities of the residents; or IV) take over the activities of the residents. Together, the 9 strategies make up a toolbox from which supervisors can select to synchronize their expert minds with the hands and minds of the residents.⁷

Supervisors' Focus on Evaluation and Decision-making

One of our main findings was that even when supervisors entrust residents with seemingly full autonomy, they still keep them under constant surveillance. This conforms with previous findings.^{7,20,32} Interestingly, overall supervisors interfered far more often in the residents' nontechnical skills of evaluation (55%) and decision-making process (30%) than they did to adjust or stop their manual activities (10%). This observation that residents' nontechnical skills seem to necessitate more guidance from supervisors than their technical skills has to our knowledge never been published before, and contributes to the growing awareness in literature that the nontechnical skills of surgeons are important competencies in the OR.^{2,3,5,33,34} This finding may have implications for how and on which skills we train our residents, be it in the operating room or in simulations.

The Supervisor's Toolbox and Its Effect on Learning

For supervisors, the main concern is patient outcome.⁷ Still, all strategies of supervisors to control residents and ensure safe and high quality care have a 3-fold effect on residents. Firstly, these strategies regulate levels of autonomy, and secondly, with each strategy supervisors hand over information and give residents insights into their expert mind. Thirdly, all actions of supervisors function as assessments. Residents continue to operate as long as supervisors do not initiate one of the 9 guiding strategies. The lack of interference by the supervisors functions as an implicit stamp of approval for the residents to continue. When supervisors do use a strategy, residents have to stop whether supervisors either approve or disapprove, and wait and see what level of autonomy will be granted to them.

Residents learn in the OR when the supervisors entrust them with progressive autonomy.^{18,35–38} Effective learning in the OR ensues when supervisors correctly assess the level of autonomy for a specific resident facing a specific activity and then select an effective strategy from their supervisor's toolbox. Interestingly, in the current study supervisors did not explore learning needs of residents during the procedure itself before selecting a strategy from their toolbox. Furthermore, in a previous study on how residents recruit expertise during surgical procedures we found that no resident explicitly communicated their learning needs to the supervisor during the procedure.³⁹

Disparities have been found in other studies between supervisors' and residents' perceptions on the subject of optimal intra-operative guidance. According to residents' perceptions, supervisors tend to overestimate the level of guidance they provided,^{36,38,40–43} but supervisors think that residents might not be able to identify or appreciate the guidance they are receiving.⁴⁴ All this raises the question of whether supervisors are able to perceive and assess the learning needs of residents during surgical procedures and adapt their level of guidance accordingly. Debriefing supervisor–resident interactions after a surgical procedure with regard to learning needs and entrusted autonomy may provide insight in the extent to which the learning needs of residents were assessed correctly and autonomy regulated effectively.

Debriefing Teaching and Learning in the Operating Room

Over the last decades, debriefing residents' performance in the OR has proven itself,^{17,45–48} but debriefing teaching interactions between supervisors and residents is a novelty in the surgical community. Our analyses open up 2 new prospects for such debriefings. Our taxonomy allows 1) a quantitative approach to supervisor teaching performances (how often did a supervisor interfere) and 2) an in-depth analysis if a selected strategy on a particular moment met the learning needs effectively. The results of such a metacognitive debriefing, in which a supervisor and a resident both discuss whether autonomy was entrusted effectively with regard to both the learning needs of the resident and the preferences of the supervisor to maintain high-quality patient care, may provide useful information to optimize learning in future procedures.

Limitations of This Study

This study also comes with some limitations. First of all not all supervisor strategies to regulate autonomy could be observed. For instance, it is known that supervisors manipulate tissues in such ways that residents are implicitly guided toward the preferred directions.⁷ Although effective in short-term patient care, such strategies may give residents a false sense of proficiency and can be harmful to patients once the residents complete their training. Second, this study reflects the faculty of our institution in 1 selected procedure. One can imagine that in other procedures, specialties, or hospitals, supervisors may use different strategies to regulate autonomy. This study is set up to provide a framework and a taxonomy that may benefit the research of supervisors' behaviors in other teaching cultures or surgical procedures. Lastly, we laid out some ideas on how our findings could improve effective learning in the OR. Such ideas need further development and prototyping before they can be useful in the daily practice of teaching hospitals.

CONCLUSIONS

In this study we shed light on how supervisors regulate autonomy in the operating room, and identified 9 strategies that supervisors consistently used. We also demonstrated that supervisors keep their residents under continuous surveillance and are particularly engaged with their evaluation and decision-making processes. Each strategy of the toolbox has a unique impact on the level of autonomy entrusted to residents, and provides expert information. To the residents, each strategy initiated by the supervisors functions as an implicit assessment of their proficiency.

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