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The critical portions of carpal tunnel release, ulnar nerve transposition, and open reduction and internal fixation of the distal part of the radius

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Topics in Training

The Critical Portions of Carpal Tunnel Release, Ulnar Nerve Transposition, and Open Reduction and Internal Fixation of the Distal Part of the Radius

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Background: Overlapping surgery is attracting increased scrutiny. The American College of Surgeons states that the attending surgeon must be present for all critical portions of a surgical procedure; however, critical portions of surgical procedures are not defined. We hypothesized that a Delphi panel process would measure consensus on critical portions of 3 common hand surgical procedures.

Methods: We used a Delphi process to achieve consensus on the critical portions of carpal tunnel release, ulnar nerve transposition, and open reduction and internal fixation of the distal part of the radius. The panelists were 10 hand surgeons (7 fellowship-trained surgeons and 3 fellows). Following an in-person discussion to finalize steps for each procedure, 2 online rounds were completed to rate steps from 1 (not critical) to 9 (extremely critical). We operationalized consensus as ≥80% of ratings within the same range: 1 to 3 (not critical), 4 to 6 (somewhat critical), and 7 to 9 (critical). Because of a lack of consensus on some steps after round 2, another in-person discussion and a third online round were conducted to rate only steps involving disagreement or somewhat critical ratings using a dichotomous scale (critical or not critical).

Results: Following the first 2 rounds, there was consensus on 19 of 24 steps (including 3 steps being somewhat critical) and no consensus on 5 of 24 steps. At the end of round 3, there was consensus on all but 2 steps (identification of the medial antebrachial cutaneous nerve in ulnar nerve transposition and clinical assessment of joint stability in open reduction and internal fixation of the distal part of the radius), with moderate disagreement (3 compared with 7) for both.

Conclusions: The panel reached consensus on the designation of critical or noncritical for all steps of a carpal tunnel release, all but 1 step of an ulnar nerve transposition, and all but 1 step of open reduction and internal fixation of the

continued

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distal part of the radius. The lack of consensus on whether 2 of the steps are critical leaves this determination at the discretion of the attending surgeon. The findings of our Delphi panel provide guidance to our division on which portions of the surgical procedure are critical and thus require the attending surgeon's presence.

The overlap of operative procedures is a longstanding practice utilized by surgeons and hospitals to maximize access to care and operating room efficiency. In teaching institutions, an overlapping surgical procedure provides the additional benefit of allowing graduated responsibility to surgical trainees[1]. This practice has come under increased scrutiny following concerns with regard to professionalism, bioethics, patient safety, informed consent, and strain to the doctor-patient relationship[2,3]. The term "overlapping surgery" refers specifically to those portions of surgical procedures during which a surgeon coincidently assumes responsibility for the care of 2 patients. Even greater concerns exist with regard to concurrent surgery, which occurs when critical portions of 2 overlapping surgical procedures coincide. In response to public interest in overlapping and concurrent surgical procedures, the American College of Surgeons (ACS) updated its Statement of Principles[4], stating that "[a] primary attending surgeon's involvement in concurrent or simultaneous surgeries on 2 different patients in 2 different rooms is inappropriate." The ACS defines critical or key portions of an operation as "those stages when essential technical expertise and surgical judgment are necessary to achieve an optimal patient outcome."[4] Provided that informed consent is obtained for both patients, overlapping (but not concurrent) surgical procedures are permissible "when the key or critical elements of the first operation have been completed, and there is no reasonable expectation that the primary attending surgeon will need to return to that operation."[4] The ACS leaves the determination of the critical components of the procedure at the discretion of the primary attending surgeon.

An inquiry by the Finance Committee of the U.S. Senate to 20 teaching hospitals revealed that there is variability in each hospital's written policies with regard to how the critical portions of a surgical procedure are defined, with the Committee staff stating that it "finds merit in the approach whereby, to the extent practicable, surgical departments with a hospital's medical staff develop guidelines that identify the critical components of particular procedures while accounting for the individualized clinical judgment the surgeon must bring to each case."[5]

In response to increased interest in overlapping surgery and the Senate Finance Committee report, we embarked on a process to define the critical portions of 3 procedures commonly performed by our attending surgeons: carpal tunnel release, ulnar nerve transposition, and open reduction and internal fixation of distal radial fractures. Through the use of the Delphi methodology, we aimed to measure and foster consensus on the critical portions of these 3 surgical procedures and to provide guidance for our division with regard to the practice of overlapping surgical procedures.

Materials and Methods

Delphi surveys are increasingly used to foster a consensus among physicians on medical practices and clinical appropriateness[6-9]. We used a Delphi panel process to achieve a consensus on which steps in 3 common hand surgery procedures are critical. When used to define medical and surgical practices, it is common for Delphi panelists to review the best available evidence prior to rating clinical appropriateness or other outcomes of interest[6]. However, this was not indicated in our project because no Level-I or Level-II evidence[10] exists to support whether a specific step in the surgical procedures under discussion are critical or noncritical. Accordingly, the Delphi panel process relied upon the clinical judgment of the panelists. We received an exemption from further review from our institution's human subjects research office.

The Delphi panelists were 10 board-certified or board-eligible orthopaedic hand surgeons from a single institution (Washington University School of Medicine): 7 attending surgeons (all fellowship-trained) and 3 hand surgery fellows (in the seventh month of their 12-month fellowship). Our Delphi panel procedure included 2 unblinded in-person panel discussions (moderated by survey methodologists) and 3 online blinded Delphi panel rounds (panelists provided ratings via computer without additional in-person discussion). The first in-person discussion included all 10 panelists meeting to edit and approve a list of steps for each of 3 surgical procedures that was identified by the first author (Table I). Three authors agreed upon the phrasing of items and the scales used in the online rounds 1 and 2. In round 1, panelists were presented with the steps and rated, on a scale of 1 (not at all critical) to 9 (extremely critical), how critical they viewed each step. Although ACS guidelines treat "critical" as a dichotomous variable (critical or not critical), we used a Likert scale to more precisely assess the panelists' sense of how critical a procedure step is. The Likert scale allows the generation of a standard deviation, which is a useful gauge of the spread of opinion across the group. During this online round, panelists were instructed that ratings of 1 to 3 would be considered not critical, ratings of 4 to 6 would be considered somewhat critical, and ratings of 7 to 9 would be considered critical. They were asked to provide open-ended comments about their ratings, particularly when they provided a rating of 4 to 6, or if they thought that their rating might be an outlier.

In round 2, panelists received the summary statistics from round 1 for each item, along with the anonymous open-ended comments that accompanied the ratings. Panelists were asked to re-rate the steps taking into consideration the results and comments. In accordance with prior recommendations for Delphi panels[11], we operationalized consensus in round 2

TABLE I Summary Statistics from Round 1 and 2

	Round 1		Round 2		Consensus After Round 2
	Median*	Mean†	Median*	Mean†	
Procedure 1: carpal tunnel release					
Skin incision (including assessment of surface anatomy)	6.5 (2 to 8)	5.7 ± 2.0	7 (5 to 7)	6.4 ± 0.8	Disagreement‡
Division of subcutaneous tissue and superficial palmar fascia	3.5 (2 to 7)	4.4 ± 2.0	3 (2 to 5)	3.4 ± 0.8	Disagreement‡
Division of transverse carpal ligament (including its proximal and distal extensions)	9 (7 to 9)	8.5 ± 0.7	9 (8 to 9)	8.8 ± 0.4	Critical
Wound closure	2 (1 to 5)	2.4 ± 1.1	2 (1 to 2)	1.9 ± 0.3	Not critical
Application of dressing	2 (1 to 5)	2.2 ± 1.1	2 (1 to 2)	1.8 ± 0.4	Not critical
Procedure 2: ulnar nerve transposition (subcutaneous or submuscular)					
Skin incision (including assessment of surface anatomy)	3.5 (2 to 7)	4.0 ± 1.5	3.5 (3 to 5)	3.7 ± 0.8	Disagreement‡
Assessment and preservation of the medial antebrachial cutaneous nerve	6 (3 to 7)	6.0 ± 1.1	6 (5 to 7)	5.8 ± 0.6	Somewhat critical§
Identification and decompression of the ulnar nerve	9 (7 to 9)	8.7 ± 0.7	9 (8 to 9)	8.9 ± 0.3	Critical
Mobilization of the ulnar nerve	9 (5 to 9)	7.9 ± 1.7	9 (7 to 9)	8.3 ± 2.0	Critical
Preparation of transposition site, including excision of medial intermuscular septum	8 (3 to 9)	7.6 ± 1.8	7.5 (7 to 9)	7.7 ± 0.8	Critical
Anterior transposition of the ulnar nerve	7.5 (6 to 9)	7.6 ± 1.0	8 (7 to 9)	7.8 ± 0.8	Critical
Assessment of the course of the transposed nerve, including release of any newfound points of compression	7.5 (6 to 9)	7.7 ± 1.1	7 (7 to 9)	7.6 ± 0.8	Critical
Hemostasis (including possible deflation of tourniquet)	3 (2 to 7)	4.3 ± 2.2	3 (2 to 5)	3.3 ± 1.1	Disagreement‡
Wound closure	2.5 (1 to 5)	2.8 ± 1.3	2 (1 to 3)	1.9 ± 0.6	Not critical
Application of splint or dressing	2 (1 to 5)	2.6 ± 1.2	2 (1 to 5)	2.2 ± 1.0	Not critical
Procedure 3: open reduction and internal fixation of the distal part of the radius					
Skin incision (including assessment of surface anatomy)	3 (2 to 7)	3.8 ± 1.8	3 (2 to 5)	3.3 ± 1.1	Disagreement‡
Surgical approach to expose fracture site	4.5 (2 to 7)	4.5 ± 2.0	5 (3 to 7)	4.7 ± 1.1	Somewhat critical‡
Fracture reduction	7.5 (3 to 9)	7.3 ± 2.0	7.5 (7 to 9)	7.6 ± 0.7	Critical
Skeletal fixation	8.5 (5 to 9)	7.8 ± 1.6	8 (7 to 9)	7.9 ± 0.9	Critical
Fluoroscopic evaluation of fracture reduction or fixation	7 (5 to 9)	7.3 ± 1.2	7 (6 to 8)	7.0 ± 0.5	Critical
Clinical assessment of joint stability	5 (3 to 7)	4.8 ± 1.6	4.5 (3 to 6)	4.6 ± 1.2	Somewhat critical§
Hemostasis (including possible deflation of tourniquet)	3 (2 to 5)	3.0 ± 0.9	3 (2 to 3)	2.8 ± 0.4	Not critical
Wound closure	2 (1 to 5)	2.5 ± 1.3	2 (1 to 2)	1.8 ± 0.4	Not critical
Application of splint or dressing	2 (1 to 4)	2.3 ± 1.1	2 (1 to 5)	2.3 ± 1.1	Not critical

*The values are given as the median, with the range in parentheses. †The values are given as the mean and the standard deviation. ‡Round 3 consensus was reached that these steps are not critical. §No consensus was reached in round 3.

as ≥80% (8 of 10) panelists rating a step within the same range: 1 to 3 (not critical), 4 to 6 (somewhat critical), and 7 to 9 (critical). This approach accommodates the number of panelists (n = 10), provides an intuitive sense of central tendency, and controls for disagreement (≥30% outside of a range), which is not easily accomplished using mean or median scores alone. There were areas of continued disagreement (lack of consensus) in round 2, leading to the second, and final, in-person discussion with the panel and the methodologists. A third, and final, round was conducted online with a new rating scale and new instructions. In round 3, participants rated only steps involving disagreement or ambivalent ratings ("somewhat critical"; mean scores of 4 to 6). The steps were rated using a dichotomous scale (1 denoting not critical and 2 denoting critical) instead of a Likert scale to facilitate arrival at consensus (if one could be reached). Additionally, panelists were instructed: "When rating steps, you are to assume the presence of a competent, appropriately experienced assistant. We do not specify the individual's job title or rank, but focus on their competence and experience relevant to the specific step."

TABLE II Excerpts of Comments from Round 1 for Selected Steps*

Procedure	Ratings 1 to 3 (Not Critical)	Ratings 4 to 6 (Somewhat Critical)	Ratings 7 to 9 (Critical)
1. Carpal tunnel release			
Skin incision (including assessment of surface anatomy)	Improper placement of the skin incision can predispose the surgeon to adverse events or a more difficult surgical dissection	A misplaced skin incision can lead to injury to other important structures and cause unnecessary difficulty with the procedure; a well-placed incision will likely lead to a better clinical outcome	The incision is key for this operation especially considering minimally invasive techniques
Division of transverse carpal ligament (including its proximal and distal extensions)	No ratings in this range	No ratings in this range	This step is the main part of the procedure and the one in which complications are most likely to occur, either with incomplete release or damage to surrounding neurovascular structures
Wound closure	Things can go wrong here but not critical	No comments provided	No ratings in this range
2. Ulnar nerve transposition (subcutaneous or submuscular)			
Skin incision (including assessment of surface anatomy)	Improper placement can be adjusted with retraction	Similar issues as carpal tunnel but less critical because the incision is much bigger (less need for absolute precision)	No comments provided
Assessment and preservation of the medial antebrachial cutaneous nerve (MABC)	No comments provided	Improper handling of the MABC can lead to a complication (painful neuroma) that is very bothersome to patients and may require future intervention; infrequent but concerning	Injury to MABC causes long-term symptoms
Preparation of transposition site, including excision of medial intermuscular septum	No comments provided	No ratings in this range	Nerve should have a smooth, unencumbered course and the path must be prepared adequately
Application of splint or dressing	Important for patient comfort and protection of transposition	No comments provided	No ratings in this range
3. Open reduction and internal fixation of the distal part of the radius			
Skin incision (including assessment of surface anatomy)	Improper placement can be adjusted with retractors	Knowledge of anatomy and surrounding structures is necessary	No comments provided
Surgical approach to expose fracture site	No comments provided	Important to avoid nearby neurovascular structures	Avoiding complications with nerves and vessels
Skeletal fixation	No ratings in this range	Technical aspects of fixation are not as critical as other steps	Critical for maintaining fracture alignment
Hemostasis (including possible deflation of tourniquet)	Not performed by all surgeons, may decrease postoperative hematoma	No comments provided	No comments provided

*Not all steps were included.

This statement addressed the fact that panelists found it very difficult to rate some steps as critical or not critical without knowing who would perform the step if the attending surgeon did not perform it. Results from rounds 2 and 3 were tabulated to determine if consensus was reached using the aforementioned threshold of 80% agreement (8 of 10 panelists).

TABLE III Summary of Consensus with Regard to Critical Steps for Each Procedure

Steps	Not Critical or Critical
Procedure 1: carpal tunnel release	
1. Skin incision (including assessment of surface anatomy) [round 3: 9 of 10 agreed noncritical]	Not critical
2. Division of subcutaneous tissue and superficial palmar fascia [round 3: 10 of 10 agreed noncritical]	Not critical
3. Division of transverse carpal ligament (including its proximal and distal extensions)	Critical
4. Wound closure	Not critical
5. Application of dressing	Not critical
Procedure 2: ulnar nerve transposition (subcutaneous or submuscular)	
1. Skin incision (including assessment of surface anatomy) [round 3: 0 of 10 agreed noncritical]	Not critical
2. Identification of the medial antebrachial cutaneous nerve* [round 3: 7 of 10† graded as noncritical]	Not critical
3. Identification and decompression of the ulnar nerve	Critical
4. Mobilization of the ulnar nerve	Critical
5. Preparation of transposition site, including excision of medial intermuscular septum	Critical
6. Anterior transposition of the ulnar nerve	Critical
7. Assessment of the course of the transposed nerve, including release of any newfound points of compression	Critical
8. Hemostasis (including possible deflation of tourniquet) [round 3: 9 of 10 agreed noncritical]	Not critical
9. Wound closure	Not critical
10. Application of splint or dressing	Not critical
Procedure 3: open reduction and internal fixation of the distal part of the radius	
1. Skin incision (including assessment of surface anatomy) [round 3: 10 of 10 agreed noncritical]	Not critical
2. Surgical approach to expose fracture site [round 3: 8 of 10 agreed noncritical]	Not critical
3. Fracture reduction	Critical
4. Skeletal fixation	Critical
5. Fluoroscopic evaluation of fracture reduction and skeletal fixation	Critical
6. Clinical assessment of joint stability [round 3: 7 of 10† graded as critical]	Critical
7. Hemostasis (including possible deflation of tourniquet)	Not critical
8. Wound closure	Not critical
9. Application of splint or dressing	Not critical

*The original wording prior to round 3 was "assessment and preservation of the medial antebrachial cutaneous nerve." †These steps had a near consensus of 7 of 10, but these did not meet our consensus threshold of 8 of 10.

Results

During the initial discussion, the group identified and agreed upon inclusion of 5 distinct steps for procedure 1 (carpal tunnel release), 10 steps for procedure 2 (ulnar nerve transposition), and 9 steps for procedure 3 (open reduction and internal fixation of distal radial fractures) (Table I). At the end of round 1, 13 of 24 steps received ratings spanning ≥5 points with a standard deviation of >1 (Table I). Panelists provided extensive comments to explain their diverse ratings; these are illustrated in Table II. After reading the comments of colleagues and reconsidering scores, at the end of round 2, panelists achieved a consensus on 19 of 24 steps (Table I); only 2 steps had a score range of ≥5 with a standard deviation of >1. However, there was no consensus on 5 of 24 steps, and the consensus on 3 steps was ambiguous (with median scores of 4 to 6, indicating the step was somewhat critical). At the end of round 3, panelists had a consensus on all but 2 steps, and these steps had only moderate disagreement (3 compared with 7) (Table III).

Discussion

In the current health-care policy environment, the determination of the critical portions of each surgical procedure is left to the discretion of the attending surgeon, with the expectation that the critical portions of 2 surgical procedures will not coincide. In addition to billing regulations from the U.S. Centers for Medicare & Medicaid Services (CMS)[12], guidance from the recently updated ACS Statements on Principles[4] has emphasized the professional responsibility of the attending surgeon in adhering to this expectation. The U.S. Senate Finance Committee's report on concurrent and overlapping surgical procedures suggests that additional oversight of the attending surgeon's presence and participation is being considered. Furthermore, there is growing opinion within surgical professional societies that overlapping surgery creates substantial professionalism and bioethical concerns[3]. The burden of regulation is expected to be placed on hospitals and surgical departments, in recognition of the differences in patient characteristics, case

complexity, and surgeon experiences among hospitals. In line with the U.S. Senate Finance Committee's goal for surgeons to establish common practice within a hospital, our division used the Delphi panel process to determine the critical portions of 3 procedures commonly performed by our attending surgeons. Following this iterative process, we reached consensus on the designation of critical or noncritical for all steps of a carpal tunnel release, all but 1 step of an ulnar nerve transposition, and all but 1 step of open reduction and internal fixation of the distal part of the radius.

Reflecting the challenging nature of this process (even for procedures that we consider routine), our group did not reach consensus on whether identification of the medial antebrachial cutaneous nerve was a critical part of an ulnar nerve transposition, with 7 members designating it as critical and 3 members designating it as noncritical in the final round of voting (the criterion for consensus was 8 of 10 votes). Those who marked that identification of the medial antebrachial cutaneous nerve was critical provided written comments that "improper handling of the medial antebrachial cutaneous nerve can lead to a complication (painful neuroma) that is very bothersome to patients and may require future follow-up" or that injury to the medial antebrachial cutaneous nerve causes long-term symptoms, and those who indicated that this step was not critical remarked that such problems are infrequent. These concerns are documented in the surgical literature[13,14].

Our group also did not reach consensus on whether clinical assessment of joint stability was a critical part of open reduction and internal fixation of the distal part of the radius, with 7 members designating it as critical and 3 members designating it as noncritical in the final round of voting. This majority (but non-consensus) among our panelists is reflected in the literature. Although there is evidence that distal radioulnar joint instability is associated with a poorer functional outcome after distal radial fracture management[15-17], more recent literature suggests that the influence of distal radioulnar joint instability on functional outcomes remains debatable[18,19].

Our panel's lack of consensus on whether these 2 steps (identification of the medial antebrachial cutaneous nerve in ulnar nerve transposition; clinical assessment of joint stability in open reduction and internal fixation of the distal part of the radius) are critical should not be interpreted as a dismissal of the clinical importance of these steps. Rather, the panel's lack of consensus leaves this determination (critical or noncritical) at the discretion of the attending surgeon, based on the individual considerations of each case including, but not limited to, patient characteristics and qualifications of the surgical assistant. Although the panelists initially tried to develop a consensus without reference to any conditions of the surgical procedure (in rounds 1 and 2), the consensus achieved in round 3 required panelists to assume the presence of a competent, appropriately experienced assistant. Crucially, the panelists chose not to define competence with references to years of experience, degrees, or job titles, which may be poor surrogates for actual, demonstrated competence. Thus, although the consensus provides some guidance to the division, the consensus continues to place the burden of responsibility on the primary attending surgeon to determine when he or she might responsibly delegate a step to another person. The challenges that our group encountered in getting to consensus for common procedures demonstrate the potential variability in opinion, indicating the importance of the attending surgeon exercising judgment in what the critical portions are for each case.

The findings of our Delphi panel provide guidance to our division on which portions of the surgery are critical and thus require the attending surgeon's presence. These findings are helpful in guiding our division's philosophy regarding patient care, particularly in an academic setting in which residents and fellows are trained. It is important to note that the purpose of a Delphi panel is not to create generalizable knowledge but rather to identify and foster consensus among a concrete group of experts or stakeholders[20]. Additionally, the composition of the panel influences the opinions that are generated. All panelists are orthopaedic surgeons in our division; no plastic surgery or general surgery-trained hand surgeons were included. Of the attending surgeons, the years of experience vary from 1.5 to 30 years in practice. Additionally, 3 hand surgery fellows (all board-eligible orthopaedic surgeons) are included in the panel, which was conducted during the seventh month of their year-long fellowship. We included fellows as important stakeholders because they bring the valuable perspective of those learning the procedures under evaluation. The varying experience among the panelists allowed for a diversity of opinions that shaped the rounds of voting and the in-person discussions between rounds. We also limited the scope of our panel to 3 procedures that are commonly performed by hand surgeons. Lastly, our Delphi panel was focused on determining which portions of the procedures were thought of as critical. Although our findings have ramifications for the practice of overlapping surgery at our medical center, we agree with the recent call to examine the appropriateness of overlapping surgery from professionalism, bioethical, and patient safety perspectives[3]. However, such an examination is beyond the scope of the current study.

Despite these limitations, we believe that the panel's findings provide a framework to other surgeons, divisions, and departments on how to approach the determination of which individual steps of a procedure are critical. These findings represent the opinion of our division at this time and may be different from those of other surgeons. It should be noted that in-person participation in the surgical timeout by the attending surgeon is mandatory at our institution, so this was not included in our candidate list of steps. For additional context, at our institution, the attending surgeon must dictate a statement of presence indicating which portions of the surgical procedure for which he or she was scrubbed; if not scrubbed, whether he or she was immediately available; and if not immediately available, which qualified attending surgeon colleague was immediately available. Concurrent surgery (in which critical portions of the surgical procedure, as determined by the attending surgeon, occur simultaneously) is not permitted at our institution. Even in the absence of a consensus as we have defined it (80% agreement), the information garnered from a Delphi

process (or another method of gaining consensus) might be used to guide the policies and practices of a hospital, division chief, or training program director by identifying majority opinion and areas of acute disagreement. The findings of our panel provide proof of concept that the Delphi methodology can be used to foster consensus through feedback and discussion of scores and comments from early rounds: In round 1, we observed a very high level of disagreement, with 18 of 24 total steps (within the 3 procedures) receiving scores with a 5-point range on a 9-point scale; in the end, we had achieved a consensus on 22 of 24 steps.

We believe that the Delphi method can be used to foster consensus on additional surgical procedures, provided that the methodology is adapted to the needs of specific groups and the nature of the immediate problem. There are several key methodological issues that should be considered if the Delphi process is used by other groups to address the critical portions of surgical procedures. First, at some point in the future, the surgical literature may be sufficiently robust that a Delphi panel process must be preceded by a critical appraisal of the literature by the panelists. Second, ratings may be provided with or without reference to caveats and conditions (such as the competence of the surgical assistant or the complexity of the patient) that may influence surgeons' judgments. Third, Delphi panels frequently engage different stakeholder groups. Engagement of additional non-experts (such as surgical residents, surgical assistants, non-hand surgeons) in the process of defining the critical portions of hand surgery might bring valuable outsider perspectives to the problem. Although such individuals are not tasked with determining the critical portions of a surgical procedure, their perspective might be useful for attending surgeons to consider when making such determinations. ■

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