Original Article

The SUPER reporting guideline suggested for reporting of surgical technique: explanation and elaboration

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Background: Surgical technique plays an essential role in achieving good health outcomes. However, the quality of surgical technique reporting remains heterogeneous. Reporting checklists could help authors to describe the surgical technique more transparently and effectively, as well as to assist reviewers and editors evaluate it more informatively, and promote readers to better understand the technique. We previously developed SUPER (surgical technique reporting checklist and standards) to assist authors in reporting their research that contains surgical technique more transparently. However, further explanation and elaboration of each item are needed for better understanding and reporting practice.

Methods: We searched surgical literature in PubMed, Google Scholar and journal websites published up to January 2023 to find multidiscipline examples in various article types for each SUPER item.

Results: We explain the 22 items of the SUPER and provide rationales item by item alongside. We provide

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69 examples from 53 literature that present optimal reporting of the 22 items. Article types of examples include pure surgical technique, and case reports, observational studies and clinical trials that contain surgical technique. Examples are multidisciplinary, including general surgery, orthopaedical surgery, cardiac surgery, thoracic surgery, gastrointestinal surgery, neurological surgery, oncogenic surgery, and emergency surgery etc.

Conclusions: Along with SUPER article, this explanation and elaboration file can promote deeper understanding on the SUPER items. We hope that the article could further guide surgeons and researchers in reporting, and assist editors and peer reviewers in reviewing manuscripts related to surgical technique.

Keywords: Surgical technique; surgery; SUPER; reporting checklist; guideline

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Introduction

Background

Surgery is an integral and indispensable part of healthcare and a prerequisite for achieving the goals of local and global health (1). Several basic surgical interventions are proved cost-effective, especially in low-resource areas (2). The volume of surgical procedures performed worldwide is estimated at 321 million (1). Up to February, 2022, in the Clarivate Journal Citation Reports category of 'Surgery', there were over 200 Scientific Citation Index Expanded journals with around 48,000 citable items, and 60 Emerging Scientific Citation Index journals with over 6,000 citable items (3). Moreover, the clinical outcomes of patients undergoing the same surgical procedures vary, at least in part explained by the variation in surgeons' technical skills. Patients operated by surgeons who have mastered a surgical technique have lower rates of postoperative complications and reoperations (4,5). However, surgical technique is often complex, difficult to standardize and reproduce, and its reporting is often largely inconsistent, incomplete, insufficiently detailed, and unclear (6-10). These situations interfere with surgeons to learn, to refine their technical skills, and objectively interferes with the evaluation of surgical technique's effectiveness and safety. Though evidence suggests that reporting guideline can improve the quality of reporting (11), the reporting quality of surgical technique remains unsatisfactory (12). Most of the studies related to surgical technique lack complete and detailed descriptions of the surgical interventions, and some even only inform the names of the interventions (8,9,13). Such unsatisfactory reporting not only affects the reproducibility of the surgical technique, but also has the potential to bias the evaluation of treatment options involving the surgical technique.

We have developed the surgical technique reporting checklist and standards (SUPER) (14) to address the issue of unsatisfactory reporting of surgical technique. The SUPER was developed by 42 surgeons, methodologists, and journal editors from 18 countries/areas around the world, following the Delphi method. The SUPER contains a total of 22 items in 6 sections, which describe in detail what we consider sufficiently detailed, complete, and transparent reporting of surgical technique. Appendix 1 provides a summary of the items in the SUPER. Of note, the SUPER can be applied to a broad range of articles related to surgical technique, regardless of the surgical specialty, novelty level of surgical technique (new, modified, or conventional), article type (case report, randomized controlled trial or others), or stage of surgical innovation.

Highlight box

Key findings
- This manuscript provides detailed rationale, explanation and elaborative examples for the 22 items of the SUPER.

What is known and what is new?
- We previously developed the SUPER reporting guideline suggested for reporting of surgical technique. However, the previous publication concentrates on the rationale, results and discussion of the development without providing explanations and elaborations for each item of the SUPER.
- This manuscript further provides detailed explanations and elaborations.

What is the implication, and what should change now?
- Users of the SUPER are strongly suggested to read this file to gain deeper understanding and to achieve optimized use of the SUPER.

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Rationale for this explanation and elaboration document

The guidance for developing reporting guidelines (15) and our published protocol (16) both have emphasized the importance of developing explanation and elaboration document for reporting guidelines. Previous reporting checklists also highlight the necessity of publishing explanation and elaboration documents (17,18). However, although the SUPER has been published (14), there is currently no detailed explanation or examples for each SUPER item. This may lead to significant differences in the understanding of SUPER items from authors, editors and reviewers, and pose practical challenges to SUPER endorse.

Objective and how to use this explanation and elaboration document

We aim to draft this SUPER explanation and elaboration document (SUPER EE), a user's manual for the SUPER, to provide explanations, rationales, and rich examples for each item.

Here are a few reminders: (I) both the SUPER EE and SUPER are only tools to facilitate better reporting of surgical technique, not to assess the quality of surgical technique. Also, no mandatory requirements exist for reporting placement, reporting order, or reporting format. (II) The examples given in the SUPER EE only suggest that they are well reported in one item or in partial requirements of one item, but do not imply that they are uniformly well reported or of high credibility or that the conclusions of the article are valid. (III) SUPER EE recommends authors report on all items rather than just some of them. It is also recommended to report as much as possible of what is mentioned in an item rather than just partial information in an item, whether in the manuscript or in the supplementary file. (IV) When reporting articles related to surgical technique, it is highly recommended to include the following statement in the article 'This article was prepared following the SUPER' and include a citation of the SUPER publication (14).

Of note, we planned to provide users with explanations from multiple perspectives, including explaining item by item, as well as providing example articles on novel, refined, and conventional surgical technique. However, as it is only months after the SUPER is published till publishing this explanation and elaboration document, we only found one published article on a novel surgical technique that has endorsed the SUPER (19). Therefore, this article is explained from the perspective of each item. It is not explained according to the degree of surgical innovation or the type of articles. Readers could further find a large number of novel, refined, and conventional surgical technical literature, and literature with different article types related to surgical technique, that have endorsed SUPER on the SUPER website "Endorse SUPER" (https://www.thesuper.org/endorse#endorse_super).

SUPER explanation and elaboration

The SUPER EE will provide an item-by-item explanation, rationale, and examples (Appendix 2).

Section one: background, rationale, and objectives

Item 1: background

Describe the background of the disease or condition (e.g., its definition, classification, clinical manifestations, epidemiological characteristics, and natural history).

Give sufficient background knowledge of the disease or condition to enable the reader to understand its burden, fundamental information about the disease, and priorities. Key indicators should be included, such as disease definition (e.g., diagnostic criteria), disease classification (e.g., acute or chronic, congenital or acquired), significant clinical manifestations, epidemiological information (e.g., global prevalence, endemic areas, morbidity, mortality), and natural history (e.g., length of illness, patient survival). These can also assist in understanding the scope of application in context (Appendix 2, Examples 1–3).

Item 2: rationale

(I) Describe the pros and cons of existing treatments for the disease or condition, including currently used single or combined surgical techniques. (II) Explain whether the proposed surgical technique is a novel or modified procedure, including whether any modifications have been made to key devices or materials. If only a conventional surgical technique is used, a brief description should be accompanied by a citation of a source which describes the surgical technique in detail.

Before describing a surgical technique, it is necessary to give the reader an overview, especially the pros and cons, of the existing treatment options, whether they are medication, surgery, or other treatments. It is also

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important to describe the rationale for mentioning the surgical technique (Appendix 2, Example 4). As the surgical technique is often a complex intervention, such a rationale can facilitate the recognition of which elements are critical rather than optional or incidental (20).

The SUPER divides articles involving surgical technique into three scenarios: (I) Scenario 1. The author proposes a novel surgical technique; (II) Scenario 2. The author modifies one/several aspects of the previous procedure(s), including modifications of surgical steps, devices, materials, etc.; (III) Scenario 3. The authors use the existing conventional surgical technique to achieve a certain research objective, e.g., to compare the safety and effectiveness of several established surgical techniques. The authors should indicate which of the above three scenarios the proposed surgical technique belongs (Appendix 2, Examples 5–7). Of note, in Scenario 2, the authors would ideally also state what modifications were made and why. In Scenario 3, the authors could briefly describe the surgical technique involved, but need to cite the literature that has a detailed description of the surgical technique involved. This allows for more transparent studies, less variation across inter-group comparisons, and greater intra-group consistency, making the results more reliable. Particularly in studies involving international and national multicenter collaborations, the lack of a clear, detailed, and consistent scheme for the conduct of the surgical technique is likely to result in substantial geographical variation in its conduct, with potential implications for the results of the study.

Item 3: objectives

State what objectives and challenges the proposed surgical technique will address. Introduce what the surgical technique figure and video will cover.

A clear description of the objective allows the reader to clearly understand and judge whether the aim has been achieved. Hence, the statement of the objective should be specific, for example by describing the classical PICO (population, intervention, comparator, outcome) approach. The author could also state the objectives by proposing a hypothesis or research question, which also needs to be described as clearly as possible (Appendix 2, Examples 8,9). Of note, the objective of the proposed surgical technique may be different from the objective of the research, especially for the research that contain surgical technique but focused on comparing the surgical technique with other treatments. For instance, in a randomized controlled trial that compares the safety and effectiveness of a surgical technique and a medication, the objectives for the surgical technique and the randomized controlled trial may be to improve the survival by removing the tumor through surgery and to find out which treatment is better, respectively. In this case, we recommend also reporting the objective of the surgical technique, in addition to the research objective, if applicable.

Furthermore, when explicitly stating the objective, authors are advised to disclose in advance what key points the article will contain (Appendix 2, Example 10). In the case of articles focusing on the surgical technique, this is what item 15 of the SUPER calls for authors to provide visual diagrams of key points or video highlights. This allows for a framework of thought for readers to read and view and aids understanding.

Item 4: classification

Classify the surgical technique, either by: (I) surgical approach: open, minimally invasive (e.g., thoracoscopic, robotic), or hybrid; or (II) treatment goal: curative or palliative.

The purpose of reporting the classification of surgical technique is to clarify and clearly define the nature of the surgical technique. If authors do not report this, in some cases the reader may have difficulty in telling which category the surgical technique belongs to, whether it is open, minimally invasive, curative, or palliative (Appendix 2, Examples 11,12). Note that although two classifications are given in the item, namely by surgical approach and treatment goal, the authors are not restricted to these two when reporting the classification.

For classifications other than surgical approach and treatment goal, authors need to find a recognized classification in the area of specialty to which they belong such as the Iwate criteria (21) and Hallas-score (22) for liver surgery (Appendix 2, Example 12). It would be inaccurate to use controversial, unspecified classifications and classification criteria that are not clearly defined. For example, during the development of the SUPER, we initially addressed the classification by degree of difficulty, which was not included in the final SUPER due to the lack of a universally agreed categorization of difficulty across disciplines.

Item 5: name

Report the names of all involved surgical techniques in the title or abstract. If the surgical technique is the focus of the paper, also include ‘surgical technique’ in the title.

Identifying literature as a specific article type and

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clearly reporting the interventions involved is very useful, as it helps with indexing in databases and facilitating search results. As with randomized controlled trials and systematic reviews, identification in electronic databases relies largely on how it is indexed, and indexers may not classify the article as such if the author does not report this information exhaustively. Therefore, to ensure that the surgical technique is appropriately indexed and easily identified, authors should use the term 'surgical technique' in the title if the surgical technique involved is at the core of the article (Appendix 2, Example 13). Whether or not the surgical technique covered is the focus of the article, the title or abstract should clearly and completely describe the full name of the surgical technique covered (Appendix 2, Examples 14,15). For example, when comparing effects of two regimens using medicine A and medicine B after surgery using a certain surgical technique, the focus is on the two medication regimens. Then, although the word 'surgical technique' may not be used in the title, the full name of the surgical technique involved should also be clearly reported in the title or abstract.

Section two: preoperative preparations and requirements

Item 6: setting

(I) Report information or requirements of the surgical environment (e.g., the name of the hospital, the hospital grade such as tertiary hospital, the degree of cleanliness, and whether the procedure must be performed in an operating theatre). (II) List and provide details of any special surgical equipment, supplies, drugs, or software used (e.g., the manufacturer, product model, quantity, dosage, route, duration, and parameters).

Surgical environment is critically important to ensure surgical quality. However, most surgical literature published to date has ignored the description of surgical environment and its related elements. This is like a recipe without a description of ingredients and seasonings, which will fail to achieve its goal. A literature review of 20 surgical clinical trials found that although the overall reporting quality has improved in the past decade, <40% of studies provided sufficient details regarding hospitals, medical staff, and surgical intervention, which compromises evidence level and generalizability (23).

(I) Before describing the surgery, the authors should first report the name of the hospital and primary or tertiary care setting of the operation (Appendix 2, Examples 16,17) and explain whether it is performed in the operating theatre as well as the cleanliness level (class I–III). For example, major surgeries like cardiac surgery and neurosurgery requires cleanliness level class I, whereas the cleanliness level of surgical debridement and endoscopy procedures is class III (24). Generally, surgical setting refers to the collection of all resource elements that allow for safe conduct of the surgery, including health personnel, medical equipment, anesthesia, sterility, and safety protocols (25). According to different medical needs, a single surgical procedure or operation can be performed in different surgical environments such as operating theater, outpatient surgery, ward, intensive care units, emergency room, etc. As the availability of medical resources differ between different operating environments, we suggest that authors focus on describing key information related to patient safety in the surgical environment, including cleanliness, anesthesia configuration, operation safety protocols, with emphasis on any measures to prevent medical errors. The importance of surgical environment is especially notable in some bedside procedures that are performed in wards, intensive care units, or emergency rooms, such as tracheotomy, emergency sternotomy, etc. In these clinical scenarios, a detailed description of the surgical environment can provide readers with the key information needed to create a safe environment for saving the lives of critically ill patients (Appendix 2, Example 18). Under special circumstances, such as emergency surgery for Corona Virus Disease 2019 patients, it is particularly important to describe how to create an environment that can fully protect the surgical team from infection (Appendix 2, Example 19).

(II) If the surgery has special requirements for medical equipment, supplies, drugs, or software, the authors should describe this relevant information in their article. Of note, we do not expect all routine information to be reported, but rather focus on describing the key information so that readers can be informed of the necessary conditions to perform the surgery. For instance, when reporting the utilization of a new surgical equipment for an operation, information

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regarding the name, the model, advantages, characteristics, and parameters of the equipment should be provided (Appendix 2, Example 20). If a drug needs to be used, the name, dosage, and route of administration should be described (Appendix 2, Example 21).

Item 7: operators

Provide information about the surgical team personnel, including their role (e.g., surgeon, anesthetist, nurse), learning curve (e.g., the number of cases), and training needed if applicable.

The paradigm of modern surgery relies increasingly on teamwork. A surgical team usually includes surgeons, anesthesiologists, other specialists, operating room nurses and medical technicians related to the surgery. The close cooperation and explicit assignment of responsibility between different team members is key to ensure patient safety and surgical quality. We suggest that the authors should report the information of surgical team members in their articles, including the tasks undertaken by different roles (such as surgeon, anesthesiologist, nurse, etc.), learning curve, elements related to training, etc., because this information is particularly important for promotion of innovative surgical techniques. In the field of surgery, training should be broadly interpreted as a term that include surgical training of the technique, the conduct of good teamwork, communication skills and supervision of responsibility, with a common goal of achieving patient safety and team efficiency (26). When describing the roles of team members, report the specific responsibilities of surgeons, nurses, and other auxiliary health personnel, as well as whether team members need to master specific skills and receive relevant training (Appendix 2, Example 22).

The reporting of learning curve is helpful to promote the adoption and application of surgical technique (27). A typical surgical learning curve can be divided into the initial stage (determined by the doctor's initial experience and technical level), the learning slope (the speed of mastering new surgical technique) and the plateau stage (the mature stage of surgical technique) (28), providing such important information for surgical training and can be used to evaluate the technical level of young surgeons. Graphically, surgical learning curve is defined as the time or number of cases (plotted on x-axis) required for surgeons to operate independently with reasonable results (plotted on y-axis, such as operation time, intraoperative blood loss, postoperative survival rate, complications, and other clinical outcome variables) (29). For example, in laparoscopic colorectal surgery, if the proportion of conversion to open surgery, the incidence of complications and the operation time are used as evaluation indicators, surgeons usually need 55–80 cases to reach the plateau stage of technical maturity (30). An ideal learning curve analysis should use a multivariable model to explain the effects of factors such as surgeons, surgical team, and the complexity of surgical cases (Appendix 2, Example 23). We suggest the authors adopt multiple clearly defined intraoperative indicators (e.g., operative time, blood loss, quality indicators related to the surgical technique) and postoperative indicators (e.g., complications, recurrence, mortality) to comprehensively evaluate the technical level of surgeons (28,29) (Appendix 2, Example 24). In surgical randomized controlled trials, surgeon-level characteristics are potential confounding factors that affect the interpretation of study results and conclusions. To minimize the impact of such confounders, we suggest that the authors describe the technical proficiency of the surgeons involved in their study (e.g., the active time in relevant surgical practice, the number of completed operations, etc.) in combination with description of the surgical learning curve (Appendix 2, Example 25).

Patient safety is always a priority issue in surgical training. Technically demanding specialties like cardiothoracic surgery have particularly high standards for surgical expertise, and thus following a traditional "learning cure" is not practically and ethically acceptable for the patient. To balance between patient safety and training efficiency, various simulation-based training modalities have been adopted in the training of modern surgeons, including computer-based virtual learning, hands-on 3D-printed models, surgical simulators such as cadaveric, animal, virtual reality (VR) and robotic simulators (31). In surgical technique, we encourage authors provide key information regarding the use of any specific simulation-based training modality that promotes training efficiency without compromising patient safety. Relevant information can include training curriculum and modules, the role of coaching mentors, the use of assessment tools, etc. (Appendix 2, Example 26).

Item 8: recipients

Report detailed indications and contraindications.

(I) Disease or condition: type, etiology, the location, shape and size of the lesion, etc.

(II) Recipients: age, sex, clinical manifestations, disease stage and severity, comorbidities and related complications, surgical history and relevant family

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history, preoperative tests, pre-intervention, and other factors pertinent to successful practice.

All surgical literature should clearly and explicitly state the indications and contraindications of the reported surgery, which is helpful for surgeons to determine whether and when to perform the surgery. By definition, surgical indications refer to a disease or pathological state requiring surgical treatment; contraindications refer to all scenarios in which surgery should not be performed due to potential harm and further classified as relative and absolute contraindications: relative contraindications refer to scenarios in which the clinical benefits may outweigh the risks in carefully selected patients, whereas absolute contraindications refer to scenarios in which the surgery may endanger the lives of patients (32). The authors should describe the surgical indications and contraindications in the two following aspects:

(i) Disease or condition. The authors should follow common practice of different subspecialties and provide a detailed description of the characteristics of disease or condition that demands for certain surgical treatment, including disease stage and classification, severity, pathological characteristics, anatomical characteristics, imaging standards, etc. (Appendix 2, Examples 27,28).

(ii) Recipients. Some demographic and clinical characteristics, including age, gender, prior medical or surgical history, comorbidity, nutritional status, and other variables, may affect the selection of different surgical approach and the timing of the operation, and may become contraindications in certain cases. For example, age is an important index variable of physiological reserve and surgical risk. For heart valve replacement surgery, age is an important influencing factor in the selection of biological valve or mechanical valve (33). Body mass index is a widely used biomarker to evaluate patients' systemic nutritional and metabolic status. In morbidly obese patients, body mass index is an important index variable to determine whether to perform bariatric surgery (34). Frailty state as indicated by very low body mass index may be a relative contraindication for some tumor surgeries. In surgical literature, it is worth noting that inclusion/exclusion criteria are not identical to indications/contraindications of the surgery. In surgical randomized controlled trials or observational studies, the authors should clearly state the indications/contraindications of the surgery while reporting the inclusion/exclusion criteria of the study population to show the important differences between these concepts, which helps to avoid misunderstanding by readers (Appendix 2, Example 29).

Item 9: recipients

Provide detailed generic information and preparations.

(I) Generic information: de-identified demographic information, symptoms and signs, imaging findings, staging, comorbidities, and relevant therapy history, etc.

(II) Preparations: cardiovascular, gastrointestinal and respiratory tract preparation, urinary catheterization, skin preparation, blood product preparation, anesthetic procedure and management, and patient positioning, etc.

Authors should provide detailed generic information that summarize patient demographics (age, gender, race), clinical characteristics (symptoms and signs), imaging studies (ultrasound, computed tomography, magnetic resonance imaging, nuclear medicine imaging, etc.), comorbidities, prior medical history, medications in use, etc. This information provides important clinical contexts to help readers understand the risks and outcomes of the reported surgery (Appendix 2, Examples 30,31). When describing patient features, it is critically important to protect patient privacy. All information must exclude identifiable information, including name, telephone and address, medical record number, social security number, date of birth, operation date, discharge date, and other information that may identify the surgical patients (35). If imaging studies and photos regarding body feature are presented, informed consent should be obtained from the patient, and attention should be paid to avoid exposing any identifiable information.

Adequate preparations before surgery are key to ensure patient safety and achieve the expected surgical results with minimized risk of postoperative complications. The author should report the details of preoperative preparation in a systems-based approach that accords with the preoperative timeline. We do not require the author to describe all details regarding preoperative preparations, but rather focus on patient's preoperative clinical risk factors, co-morbidities and necessary prevention measures that reduce potential adverse events related to the surgery.

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(I) Clinical management of preoperative risk factors and comorbidities. For example, patients with cardiovascular diseases and risk factors, including coronary disease, hypertension, diabetes, atrial fibrillation, smoking status etc. are important causes of cardiovascular adverse events after non-cardiac surgery (36). Preoperative preparation for such patients should focus on cardiovascular related examinations, such as ECG, cardiovascular imaging, and biomarkers, etc. If cardiovascular medications are used for prevention before operation, the name, dosage and duration should be described; if patients have medications in use at baseline, authors should describe whether and when to stop the medication before operation or whether and how the dosage is adjusted (36). Preoperative preparations for other organ systems are not listed here in details due to space constraints.

(II) Clinical management and prevention of surgery-related adverse events. Common preparations include nutritional support, preventive use of antibiotics, gastrointestinal preparation, etc. Attention should be paid to preoperative preparation in some special patient groups, including pregnant women, elderly patients, and children. Importantly, the authors should describe specific preoperative preparation measures to reduce the risk of certain adverse events related to the surgery. For example, cardiac surgery under cardiopulmonary bypass increases the risk of postoperative renal injury, which can be prevented by optimization of hemodynamics and avoidance of nephrotoxic medications (37). If special requirements for anesthesia management exist, the authors should describe the key points of anesthesia in the reported surgery (Appendix 2, Example 32). Patient positioning is another key point in preoperative preparation. If the patient positioning in certain innovative surgeries is different from that in conventional surgery, the author should describe it in detail (Appendix 2, Example 33, refer to item 10 for more details). In summary, preoperative preparations are usually completed by surgeons and anesthesiologists with different specialty emphasis, and we encourage authors to share their experiences in preoperative preparations to improve patient safety in their article.

Section three: surgical technique details

Item 10: surgical approach, key anatomic landmarks, and adjacent structures

(I) Describe in detail how to establish the surgical approach (e.g., devices and equipment used, the position of the surgeons, anatomic localization, and the incision type, length, size, depth, angle, and number). (II) Describe the essential anatomic landmarks and adjacent structures, including areas, structures, blood vessels, and nerves, etc. (e.g., 'use the Louis angle between the sternal manubrium and the sternal body to find the second costal notch').

A surgical approach (or access) is where the surgeon enters the patient's body from the surface (Appendix 2, Examples 34–36). For ease of remembering, these can be broadly divided into natural or artificial openings. Trans-natural approaches include natural orifices (such as gastroscopy and laryngoscopy) and interventional procedures with a percutaneous approach. These procedures are usually minimally invasive approaches. The artificial opening approach, which requires an incision on the surface of the body or through the mucosa to gain access to the interior of the body (usually more invasive than the natural opening), can be further divided into minimally invasive procedures such as laparoscopic appendectomy, and open procedures such as a median abdominal incision for gastrectomy. The open surgical incisions are also categorized by size further, such as a full sternotomy or an upper sternotomy. There are some procedures that may use multiple approaches, also known as hybrid surgery (38). It is important to note that the concept of 'minimally invasive' is becoming increasingly popular when describing surgical access but is inherently ambiguous as the size of trauma is a relative rather than an absolute concept and the definition of 'minimally invasive' may vary between disciplines. The International Statistical Classification of Diseases-10 Procedure Coding System describes the detailed classification of surgical approaches (39): open, percutaneous, percutaneous endoscopic, via natural or artificial opening, via natural or artificial opening endoscopic, via natural or artificial opening with percutaneous endoscopic assistance, and external. There may be several surgical approaches to the same disease, and the surgical approach may evolve over time (40). Innovations in the surgical approach have also been reported independently (41). For any operation, the

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surgical approach is the first step, and in many cases the first step that determines the difficulty of the operation and even its success and efficacy.

The surgical approach contains several important points that should be clearly described in the surgical technique. For example, the instruments (Appendix 2, Example 36), the position of the patient (Appendix 2, Examples 34,36), the position of the surgeon and assistant (for instance, the surgeon is usually on either side of the patient in general surgery, but on the foot side in transurethral resection of the prostate), the characteristics and number of incisions (even in thoracoscopy, there is single-port approach and double-port approach, etc.). Another key point is the anatomical features (Appendix 2, Example 35), including anatomical landmarks (how to ensure accurate placement of the incision) and the surrounding critical structures (how to avoid damaging important vessels and nerves adjacent to the incision, etc.). In fact, the creation of a surgical approach can be seen as a relatively complete operation itself, especially given that in practice the surgical approach is usually performed by a junior surgeon. We recommend that medical illustrations are also provided for the surgical approach whenever possible, especially for unconventional approaches (refer to Item 15).

Item 11: intraoperative monitoring

Describe intraoperative monitoring specifically related to the surgical technique (e.g., near-infrared spectroscopy in aortic arch surgery).

Intraoperative monitoring ensures smooth and safe surgery, improves perioperative outcomes, and reduces adverse events by using constantly calibrated data on the cardiopulmonary, neurological, and metabolic functions to guide pharmacological and physiological therapy. Anesthesia is an integral part of the surgery. While the surgeon concentrates on the operation, the anesthetist is primarily responsible for the intraoperative monitoring of the patient. All patients undergoing any form of anesthesia are monitored to some degree. American Society of Anesthesiologists has set out basic monitoring standards for anesthesia (42). The patient's oxygenation, ventilation, circulation, and temperature should be continuously assessed during all anesthetic periods. For the surgical technique report, detailed coverage of unconventional monitoring techniques should be highlighted. This includes the monitoring equipment used, parameters, abnormal values, and clinical significance. For example, near-infrared spectroscopy is used to monitor cerebral perfusion during aortic arch surgery, somatosensory-evoked potentials, or motor evoked potentials used to monitor spinal cord function during spinal surgery, etc. For more elaborations, please see Appendix 2 Examples 37–39.

Item 12: step-by-step description

Include all relevant details of each operative step in a step-by-step manner along with both quantitative and qualitative description. (I) Details may include the intraoperative findings, timeline, histomorphology, exposure of vital structures, extent of lymph node dissection, determination of surgical margins, suture pattern (running suture or single stitches; spacing of stitches), anastomosis, knot-tying, specimen handling, and devices/supplies/drugs/blood products used, etc. (II) Note the operative time. (III) If a non-conventional maneuver was applied, specify the reason.

Surgery, as a complex operation, is carried out in chronological order. Each complex operation can be divided into a number of sessions. We recommend a step-by-step method for the description of the operation (Appendix 2, Example 40), i.e., a chronological description of the procedure. In this way, the description is consistent with the actual development of the procedure and is clearly organized and easily understood by the reader. This step-by-step description also breaks down the entire complex surgical procedure, making it easier to remember. We believe that a clear description should contain at least the following details: intraoperative findings, timeline, histomorphology, exposure of vital structures, the extent of lymph node dissection, determination of surgical margins, sutures pattern (running suture or single stitches; spacing of stitches), anastomosis, knot tying, specimen handling, and devices/supplies/drugs/blood products used, etc. Note that the above elements do not apply to every type of surgery, and there may be some important elements that we have not listed. Our crude examples are only intended to inspire the reader for more detailed reporting. Of course, we should not go from the extreme of cursory to the extreme of detail.

To give a detailed description of a procedure is not to keep a running account of every detail well-acknowledged in the surgical community, such as the six-step handwashing and the wearing of sterile gloves, making the article a tasteless pile of details. It is worth covering in detail the core aspects of the operation, where the operation can go wrong, where there are variations from traditional operations, and details that readers care about or find interesting. Also,

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in our experience, it is rare for surgical technique reports to mention the duration of the operation (Appendix 2, Example 41), especially when the technique is first reported. Surgical duration and surgical difficulty are positively correlated and can even affect the prognosis of the patient. Also, operative duration reflects the learning curve. We recommend that the authors report this variable. Finally, surgery is a process of clinical challenge and resilience. During surgery, some non-conventional maneuvers may be performed due to unforeseen circumstances, and the reasons for this should be fully explained. Of course, non-conventional maneuvers may also be performed because the operation has advantages that traditional operations do not have (Appendix 2, Example 42), or simply because of the surgeon's personal preference, all of which should be stated.

Item 13: quality and consistency

Describe tips and skills for ensuring surgical quality and consistency, especially for the key steps and any conditions or variations that require uniform management (if applicable). For example, using standardized training, establishing quality control teams, and organizing multidisciplinary consultations.

Most of the current surgical technique articles do not actually report on quality and consistency controls. We believe that this section is important and part of clinical practice, needing to be reported. The Affordable Care Act of 2013 (43) has invested heavily in the development of outcome measures to better evaluate the quality of care. The Institute of Medicine has also proposed 'To Err is Human' (44) and 'Crossing the Quality Chasm' (45). Good quality and consistency of the procedure mean that the stability of the procedure is greater and the confidence of the operator and the patient in the procedure is higher. In order to assess quality and consistency, the surgical technique report should clearly define the purpose of the procedure and the indicators to be evaluated. Although most of the indicators are qualitative, it would be useful if quantitative indicators were available, such as the Pulsatility Index and flow (Appendix 2, Example 43) measured by transient flow after coronary artery bypass grafting. The surgeon can assess whether the procedure is difficult or easy and whether the outcome is good to poor. There are various methods of quality control, such as standardized training (Appendix 2, Example 44), quality control teams, multidisciplinary consultations, Cumulative Sum analysis (46), and Medical Errors Reporting System (47), subspecialty or disease-specific scores (e.g., EuroScore) (48), etc. Surgical simulation models can also help ensure consistency in training by providing standardized and repeatable scenarios for trainees to practice on. This can help to ensure that all trainees are exposed to the same level of training and can develop their skills in a consistent and measurable way.

Item 14: safety

Describe tips and skills for ensuring safety. For example, how to prevent or deal with possible intraoperative complications and emergencies, or when and how to undertake a surgical conversion.

There is some overlap between this entry and quality and consistency, but there are also different nuances. 'Quality and consistency' places more emphasis on 'do more good', while 'safety' emphasizes 'do less harm'. Although the aim of surgery is to save lives, unsafe surgical management can also cause considerable suffering. Mortality rates after major surgery are reported to be 0.5–5%; up to 25% of patients experience complications following inpatient surgery; nearly half of adverse events in hospitalized patients in industrialized countries are related to surgical treatment; at least half of surgical injuries are considered preventable; and in some parts of sub-Saharan Africa, the mortality rate from general anesthesia alone is as high as 1 in 150 (49). In an effort to systematically improve the safety of surgical procedures, the World Health Organization (WHO) also published the WHO Surgical Safety Checklist in 2008 (50). In addition to systematic risk prevention mechanisms, the disclosure of problems and solutions that may be encountered during surgery is essential for the surgical learner to have a more comprehensive understanding of the procedure and to complete it successfully (Appendix 2, Examples 45–47). For example, thyroid surgery can damage the recurrent laryngeal nerve and carotid artery. In addition, there may be multiple surgical treatments for each disease, and each has its own advantages, disadvantages, and indications. We should plan well in advance of surgery to choose the best surgical option. However, many decisions can only be made intraoperatively under direct inspection. When a procedure is found to be unsuitable intraoperatively, it is advisable to transfer to another procedure to ensure the safety of the operation. For example, laparoscopic cholecystectomy with uncontrollable hemorrhage requires urgent conversion to open surgery; trans-aortic valve replacement valve release affecting the coronary opening should be converted to open aortic valve replacement. The information on these special circumstances will enable the

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learner to anticipate and be aware of them.

Item 15: visualization

(I) Visualize the key steps in a step-by-step and self-explanatory manner. Consider using narrated video(s) and anatomic illustration(s) with designated symbols and illustrated text. (II) The key information in item 12 should be visualized; it can either be presented as a stand-alone figure or embedded in the video(s). (III) Visualization of the key information in items 10, 13, and 14 is encouraged as appropriate. (IV) After peer review, add clips into the video(s) to present the video title, operator name, and operation date at the beginning, and the informed consent and the ethical approval statements at the end.

The surgical illustration (Appendix 2, Examples 48–50) is the artwork to showcase complex surgical details in an engaging, visual, and efficiently understandable way. Surgical procedures are very complex and contain many details, some of which are difficult to describe in words, and the existence of many languages around the world makes it even more difficult to communicate surgical techniques in words. As the saying goes, a picture is worth a thousand words, and visualization allows people to better understand the essence of what the text is trying to convey. Mavroudis *et al.* have summarized seven practical visualization tips: (I) hovering technique; (II) hidden anatomy, ghosted views, or transparency; (III) centrally focused perspective; (IV) action techniques to give life to the procedure; (V) use of insets to highlight one part of the drawing; (VI) human proportionality using hands or known objects to show relative size; and (VII) step-by-step educational process to depict the stages of a procedure (51). Surgical visualization can take a variety of forms, as long as the procedure is clearly communicated, including images, hand drawings, videos (Example 2), and even advanced visualization techniques such as 3D visualization, augmented reality, and virtual reality. Surgical visualization has a certain degree of subjectivity and freedom but is by no means without rules. We believe that there are some basic elements that must be included: the key information in Item 12 should be visualized; it can either be presented as a stand-alone figure or embedded in the video(s). Visualization of the key information in Items 10, 13, and 14 is encouraged as appropriate. After peer review, add clips into the video(s) to present the video title, operator name, and operation date at the beginning, and the informed consent and the ethical approval statements at the end. The primary reason for doing this is that surgical videos can spread independently from the article. Adding clips containing the required information to the video allows minimizing the loss of important information even when the video is disseminated independently. Of note, although SUPER's scope is peer-reviewed articles on surgical technique, given surgeons' enthusiasm for sharing non-peer-reviewed videos on multimedia platforms, we also appeal to surgeons to consider adopting the above recommendations for surgical videos in social media sharing.

Section four: postoperative considerations and tasks

Item 16: evaluation

(I) Define the criteria for success and failure, and evaluate the efficacy or effectiveness of the surgical technique from both the technical aspect and the clinical outcome perspective (e.g., length of stay, improvements in short- and long-term mortality, recurrence, survival time, and patient impairment). (II) When possible, include the perspective of the patient (e.g., symptoms and signs, postoperative pain, and aesthetic results).

(I) Postoperative evaluation is an important stage to judge whether the surgery meets the expected goal. The authors should clearly define the success/failure criteria of the surgery and pre-specify evaluation metrics accordingly (Appendix 2, Example 51). The evaluation of the efficacy or effectiveness of the surgical technique should focus on these two aspects: technical aspect and clinical outcomes. Commonly used criteria for surgical evaluation should align with the expected objectives of the surgery, including obtaining a diagnosis, restoring physiological or anatomical functions, improving survival, relieving pain, and improving the quality of life. From the surgical perspective, evaluation criteria should cover indicators related to specific surgical techniques. For example, for valvuloplasty and valve replacement procedures, valvular function should be evaluated postoperatively using cardiac echocardiography (52). In addition, common variables such as operative time, intraoperative blood loss, usage of blood products, and tissue injuries can be adopted for evaluation. The evaluation of postoperative outcomes commonly includes length of hospital stay, death, disease recurrence, etc. Notably, the author should distinguish between efficacy and effectiveness when describing surgical evaluation.

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Surgical efficacy is usually used in exploratory studies to evaluate whether a surgical technique can achieve the expected surgical results under ideal conditions, whereas surgical effectiveness is usually used in empirical studies to evaluate the actual clinical benefits of the surgical technique in a real-world environment (53). The authors should choose which term to use according to the nature of their studies.

(II) Surgeons should not only care about surgical outcomes and treatment effects, but also pay more attention to the overall physical, psychological, and social health status of their patients. When evaluating surgical outcomes, we encourage the authors to collect patient reported outcomes in addition to conventional endpoints for a more comprehensive evaluation the clinical benefits of a surgical technique. The patient reported outcomes are reported directly from the patient about his or her own health status, without explanation by the clinician or anyone else (54). In recent years, the evaluation of patient reported outcomes had become an important tool to assess the efficacy and effectiveness of surgery (55) and it generally includes disease-related symptoms, level of pain, and physiological and anatomical functions of affected organs. For example, after surgical correction for complex humeral fractures, surgeons would evaluate the anatomical function and mobility as well as the pain score of the affected limb (Appendix 2, Example 52). A more general evaluation of patient reported outcomes is the evaluation of health-related quality of life, which is usually completed by doctors using well-designed questionnaires that include the assessment of physiological function, mental health status, and social interactions (56). At present, different clinical specialties have developed well-recognized standardized tools to evaluate and quantify health-related quality of life. For example, health-related quality of life assessment in patients with heart failure can be completed by Kansas City Cardiomyopathy Questionnaire (57). The health-related quality of life of cancer patients can be evaluated using European Organization for Research and Treatment of Cancer-Core Quality of Life Questionnaire (58). We suggest that the author choose specific evaluation tool according to the clinical needs of different patient groups and report the contents, measurement, method, and frequency of postoperative patient reported outcomes evaluation (Appendix 2, Example 53).

Item 17: postoperative monitoring

Describe in detail postoperative monitoring specifically related to the surgical technique (e.g., monitoring indicators, devices, frequency or duration, examination, and nursing required).

Postoperative monitoring is an important part of surgical quality control. After defining the evaluation criteria for surgical success or failure, the author should describe in detail how to monitor indicators during postoperative period and/or after discharge, especially indicators related to the surgical technique. For example, in patients with endovascular aneurysm closure by chimney technique, multiple computed tomography angiography and specific software are used to monitor the displacement of endovascular stent (Appendix 2, Example 54). If a specific medical device is used in postoperative monitoring, we suggest that the author report the name, the model of the device, the timing as well as duration or frequency for monitoring. For example, in patients after cardiac surgery for atrial fibrillation, Holter device (a specific medical device that continuously monitors cardiac electrical activity in real time) is utilized by physicians to monitor the number and frequency of recurrence of atrial fibrillation (Appendix 2, Example 55).

Item 18: complication prevention and management

Report the possible or observed postoperative complications and their prevention and management, especially complications that differ from those related to conventional techniques.

There is a risk of complications in any surgical operation. In general, postoperative complications refer to any adverse event that may require medical treatment or surgical, endoscopic and radiological intervention, resulting in the deviation of postoperative rehabilitation process (59). In recent years, although advances in perioperative management have significantly improved surgical safety, the occurrence of postoperative complications still causes substantial burden in the health care system. In patients over 45 years old who underwent major non-cardiac surgery, more than 10% would develop serious complications, and more than 1% would die in hospital or within 30 days after operation (60). Given its importance, the authors should

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report prevention and management measures related to postoperative complications.

Common complications are related to anesthesia, suture, and postoperative physiological status, including fever, wound bleeding, and infection, etc. The author should provide a focused description of the prevention and treatment measures in a systems-based approach. For example, analgesia helps to reduce the risk of surgical complications, and good pain control and management can facilitate rapid postoperative rehabilitation (61). If possible, the author should report whether the postoperative pain assessment is performed and if there is any relevant pain management plan, including the start time of analgesia, drug name and dosage, duration, and discharge medication (Appendix 2, Example 56). More importantly, the authors should focus on prevention and intervention measures for complications specifically related to the surgical technique. For example, complex congenital heart surgery and valvular replacement surgery may lead to heart block, which requires the insertion of cardiac pacemaker (62). The authors should report all possible and common complications related to the surgical technique. If possible, the differences in postoperative complications between new and traditional technique can be compared. Of note, the authors should consider adopting standardized tools in their fields to classify postoperative complications and describe the advantages and values of such tools (Appendix 2, Example 57). For example, Clavien-Dindo classification system (59) and its Comprehensive Complication Index (63) has been proposed to classify surgical complications into I–V levels based on the need and the level of medical intervention. This classification system has been widely used in many surgical specialties and provides a standardized tool to evaluate and compare surgical outcomes, perioperative management quality, and medical expenditure (64).

Item 19: follow-up

(I) Report the details of follow-up visits, including pathway, frequency, duration, and indicators (e.g., pathway-'telephone follow-up'; frequency-'radiological examinations every 3 months'; duration-'up to 3 years'; indicators-poor outcomes, complications, quality of life, and unexpected events). (II) If applicable, compare the information in Item 19a with those of conventional techniques.

Postoperative follow-up is the continuation of surgical management and an important stage to observe short-term and long-term surgical effects. The frequency, time, mode, and content of postoperative follow-up are determined by many factors, such as the natural history of the disease, surgical characteristics, patient compliance, availability and accessibility of medical resources, etc. We suggest that the author report the details of follow-up visits, including pathway, frequency, duration, and indicators. If necessary, the difference in outcomes between new and conventional technique during follow-up should be compared.

All follow-up events (or so-called study endpoints) should be clearly defined in advance. Compared with in-hospital evaluation, postoperative follow-up focuses on the long-term effects after surgery. Generally, the content of postoperative follow-up is usually divided into those related to surgical technique and clinical outcomes. For outcomes related to surgical technique, surgeons can evaluate long-term impact of the surgery, monitor temporal changes in anatomical and physiological functions, observe trends of improvement or deterioration in disease or condition, and assess the necessity of reoperation and the timing of intervention. For patients' clinical outcomes, endpoints such as long-term mortality, complication rate, emergency hospitalization and quality of life are commonly emphasized (Appendix 2, Examples 58–60).

The mode of postoperative follow-up and collection of relevant data deserves additional attention. In fact, follow-up mode is one of the key factors that determines the quality of follow-up. Common follow-up modes include regular outpatient clinic visit or telephone interview. In recent years, wearable devices and telemedicine technology have become increasingly important in postoperative follow-up in some specialties, which helps to reduce the risk of lost to follow-up and improve the accuracy of data collection. The diversity of follow-up modes is also reflected in the different data sources. For example, researchers from developed countries can track survival status, emergency medical treatment and admissions of patients after surgery by linking multiple administrative databases to achieve the purpose of long-term follow-up (Appendix 2, Example 61). We encourage the authors to disclose the follow-up mode and methodology of data collection based on their study design.

Section five: summary and prospect

Item 20: strengths, limitations, and outlook

Discuss the main strengths and limitations of the surgical technique, and provide detailed suggestions for improvement and future outlooks.

It is essential to report on both the strengths and

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limitations of the surgical technique, especially the transparent reporting of the limitations. This allows the reader to grasp the main points without being overly optimistic and can provide a key orientation for further refinement and improvement. In terms of strengths, these can be as varied as improved patient survival or quality of life, improved operation duration or convenience, increased safety, reduced costs, etc. For limitations, specifically, the author needs to mention the requirements to achieve good results, the conditions in which the surgical technique may not be suitable, whether the surgical technique is carried out seeking multidisciplinary or patient values and preferences and provide information on how these limitations may have specific implications (e.g., which steps are difficult to achieve stability). Also, where possible, consider comparing the results and implementation with results and implementation from other techniques. In addition, the author should propose directions for future improvement and provide a vision for the future application of the surgical technique (Appendix 2, Examples 62,63). This would motivate the authors to improve and not to be satisfied with the status but would also give readers from different contexts more room for learning and possibilities for optimization.

Item 21: impact and cost

(I) Summarize the key points and take-away lessons of the surgical technique and its impact in the clinical setting and on society (e.g., the economic cost). (II) Consider in context the predominant cost and its potential impact on the implementation and adoption of the surgical technique.

A clear reporting of the clinical and social impact of the surgical technique is of utmost importance to promote better allocation of healthcare resources and priority setting. Authors are encouraged to think about the multidimensional impact of the surgical technique based on the rationale and objectives in Items 2 and 3. For clinical impact, the authors can consider several clinical perspectives, which could be a reduction in the length of the procedure, an increase in the safety of the procedure, an increase in patient survival, a reduction in complications, etc. For social impact, the authors need to consider the technique in a wider context such as politics, economics, and culture. For example, if patients with certain religions refuse to undergo certain procedures, could the technique be a good solution to this issue so that more people can benefit? Another example is the social benefits of a technique, i.e., if a surgical technique requires fewer blood products and can be performed without a complex team and is suitable for certain situations, such as war zones. Specifically, the impact statement should be developed in relation to the key points and take-away lessons of the surgical technique and should be considered in context (Appendix 2, Example 64). The take-away lessons are summaries of the author's advice to colleagues, considering a combination of key points, settings, and other factors. Contextual considerations are crucial for judging the scope of applicability and impact, including which settings the surgical technique is primarily used in, for example, general practice (primary care), low and middle-income countries, community versus specialty hospitals, or inpatient versus outpatient settings (also refer to Item 6).

The SUPER pays particular attention to the cost issue, especially the cost of novel surgical technique and modified surgical technique. Health needs are vast and healthcare resources are limited. Authors need to take into account the cost factors that limit the development and adoption of the surgical technique (Appendix 2, Example 65). It is preferable when cost-effectiveness data and analysis are available (e.g., disability adjusted life years avoided per cost). Even if cost-effectiveness information is temporarily unavailable, the impact of cost on the implementation of surgical techniques should be considered. This can be a key consideration for the health policymaker. For example, if the implementation of a surgical technique requires new and expensive device or equipment, this may be an important obstacle to its implementation in low- and middle-income areas. An example is the trans-aortic valve replacement procedure, which meets the clinical needs of some patients who are unable to undergo surgical aortic valve replacement, but the high cost and high price of trans-aortic valve replacement treatment makes it a major challenge to reach more patients, and thus its social impact is greatly limited. In addition to economic cost, the authors can think outside the box to consider other factors that may affect the development and adoption of surgical technique, such as safety, efficacy, resources needed, equity, feasibility, acceptability, etc. These all provide important information to assess the applicability of the surgical technique to specific settings of the end users and the main barriers faced.

Section six: other information

Item 22: conflicts of interest, ethical approval, and informed consent

(I) Specify any potential conflicts of interest; (II) include the ethics committee or institutional review board approval

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(and the number when applicable); and (III) provide the informed consent for publication.

Conflicts of interest disclosures have the potential to reduce bias, yet the current disclosure of conflicts of interest is worrying (65,66). Every author should disclose their conflicts of interest, both financial and non-financial, as defined by the International Committee of Medical Journal Editors (67) and as required by each journal. For example, if a new device is introduced in a surgical technique, the relationship between the manufacturer and the authors should be disclosed (Appendix 2, Example 66). Another example is that if the project is supported by a funder, the funder's involvement and role in the development of the project should be disclosed (Appendix 2, Example 67).

The authors need to ensure that the ethics committee has approved the project and provided an ethics approval number (Appendix 2, Example 68). Research has found that in the field of surgical technique, many surgeons underestimate the importance of obtaining and reporting ethical approval and that there is much room for improving the reporting of ethical approval (66,68,69). Research conducted without ethical approval or even falsified ethical approval documents is at great risk (70).

Authors should also obtain informed consent signed by the patient for writing and publishing the article (Appendix 2, Example 69). If this cannot be obtained from the patient, it should be obtained from the patient's relatives, when local regulations permit. The article should clearly give the statement 'Signed informed consent was obtained from the patients'. When informed consent could not be obtained, the author needs to ensure that all possible attempts have been made and clearly give the reason and the statement 'Signed informed consent was not obtained after all possible attempts were made' or 'Signed informed consent was not obtained due to ...'.

Discussion

Surgical technique serves the individual patient, as it is an important component of the evidence-based medicine and individual patient care; it also serves clinical science, as a good description of surgical technique can potentially contribute to the formulation of new scientific hypotheses; and it definitely serves education, as a high level of surgical technique can promote critical thinking and create skills for lifelong learning. Through the SUPER, we hope the reporting quality of surgical technique will improve, thus facilitating better patient care, science, and education.

To the best of our knowledge, SUPER was the first to provide a comprehensive list of items to define the detailed reporting of surgical technique. Hopefully, this SUPER EE document can be of practical use for surgical technique developers and adopters. Moreover, reviewers, editors, and readers may find it beneficial. We welcome feedback, comments, and suggestions from readers on how to improve the SUPER.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://gs.amegroups.com/article/view/10.21037/gs-23-76/coif). KZ, GSL, XT and SDW are staffs of AME publishing company (the publisher of *Gland Surgery*). The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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