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Rapid assessment of technical competency: the 8-min suture test

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ABSTRACT

Background: Although simulation training and evaluation have become increasingly popular for teaching minimally invasive surgery, tools to measure open surgical skills remain underdeveloped. As there is increasing demand for objective measures of technical competency at the completion of surgical training (postgraduate year [PGY]-6 and -7), this project was designed to assess the feasibility, reliability, and validity of a novel open surgical skills evaluation tool, the 8-min suture test (8MST).

Methods: During an annual surgical skills laboratory session, fellows and residents were asked to complete a simulated end-to-end vascular anastomosis. They were limited to 8 min to perform the anastomosis between two 12-mm Dacron grafts mounted on a customized platform. Their real-time and video-recorded performance was scored by two blinded evaluators and compared with their faculty-rated technical performance on clinical rotations completed around the time of 8MST administration.

Results: PGY-6 and PGY-7 trainees were compared across several domains including 8MST total score (4.6 *versus* 5.5, $P = 0.030$), 8MST setup score (2.3 *versus* 2.4, $P = 0.797$), 8MST technical score (2.3 *versus* 3.1, $P = 0.026$), and clinical performance score (3.1 *versus* 3.6, $P = 0.006$). Comparison of 8MST total score to the clinical performance score identified a strong relationship with a Pearson $r = 0.55$ ($P < 0.001$) and $r^2 = 0.30$. Additionally, 8MST displayed high inter-rater reliability and test–retest reliability.

Conclusions: The 8MST is a rapid, feasible, inexpensive, reliable, and valid test for assessment of surgical trainee technical abilities.

1. Introduction

Modern surgical education remains focused on the concepts of graded responsibilities and coordinated education, as initially pioneered by William S. Halsted in the nineteenth century [1,2]. Although these elements and the, "see one, do one, teach one," philosophy remain cornerstones of surgical training, recent trainees have seen a significant shift in their operative experience [3]. This shift can be attributed to several factors including Accreditation Council for Graduate Medical Education duty-hour restrictions [4], increased adoption of minimally invasive surgery (MIS) and endovascular techniques [3,5,6], early transition to subspecialty training (e.g., integrated vascular, plastic, and cardiothoracic surgery training programs) [7,8], and the rise of nonoperative trauma management [9–11]. In addition to

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these factors, the current nature of surgery training encompasses the simultaneous obstacles of a broader array of procedures that are increasingly complex [12], placing a greater premium on development of fundamental open surgical skills.

The recently intensified scrutiny of surgical outcomes at teaching hospitals [13,14] has placed pressure on surgical training programs to focus on patient safety, in many cases resulting in a loss of trainee autonomy. Particularly for MIS, this pressure has spurred the adoption of simulation as a method for teaching and evaluating surgical skills, such as the fundamentals of laparoscopic surgery (peg transfer, precision cutting, ligating loop, suture with extracorporeal knot, and suture with intracorporeal knot) [15]. Currently, MIS simulations exist for many laparoscopic procedures including inguinal hernia repair [16,17], cholecystectomy [18,19], and colectomy [20]. Several large systematic reviews have concluded that technical skills learned during simulation of procedures translate to improved trainee performance in the operating room [21,22]. This is of paramount importance, as pure MIS technical ability has now been shown to correlate with patient outcomes [23].

Despite advances in MIS simulation, open surgery has lagged behind. There is currently a scarcity of validated open surgical simulation models [24,25]. Furthermore, studies on learner performance using the open models have focused on medical students, junior residents, and senior residents [26–28]. There has been very little focus on testing the technical ability of trainees at the terminus of their training experience. The current gold standard for assessing open technical skills is *ad hoc* evaluation of trainee performance in the operating room. This method is impractical because of inadequate training of the evaluator, inadequate structured measures, and time required by the instructor who must simultaneously balance the need for efficiency with the educational needs of the trainee.

To address these gaps, we sought to develop and validate a surgical simulation aimed at assessment of open technical abilities of surgical trainees. The test was designed to incorporate each of the principles of the global rating scale of operative performance (respect for tissues, time and motion, instrument handling, knowledge of instruments, flow of the operation, uses of assistants, and knowledge of a specific procedure on a 5-point scale) [29].

2. Methods and materials

2.1. Participant information

During annual skills laboratory sessions conducted from 2011–2014, surgical oncology fellows, breast surgery fellows, hepatobiliary surgery fellows, and rotating surgical residents participated in an administration of the 8-min suture test (8MST) during the first quarter of the academic calendar year (July–September). Participants were provided no feedback with regard to their performance and were allowed to participate even if they had taken the test in a prior year.

2.2. Materials

For the 8MST, the trainee was presented with two pieces of 12-mm diameter Dacron vascular graft (Terumo Medical Corp., Somerset, NJ), secured to a rigid platform, two double-armed 4-0 SH needle Prolene suture (Ethicon, Somerville, NJ), one heavy and one light Mayo-Hegar needle driver, curved and straight Mayo scissors, and two DeBakey forceps with 1.5-mm tips (Fig. 1). Each participant was provided with an expert surgical assistant who was instructed only to follow directions given by the participant and not to make autonomous decisions regarding how to best assist the participant. The participants were instructed to use the materials provided to form an end-to-end anastomosis within 8 min. A stopwatch with an audible alarm was used to delineate the 8-min period for each participant. Each 8MST was video recorded on a digital camera mounted to a tripod placed immediately adjacent to the testing station. The 8MST station was constructed using a 43 cm × 30 cm × 1.8 cm (16 inch × 11.5 inch, $^{3}/_{4}$ inch thick) piece of standard plywood wood, two alligator clips with a magnetic variable length mechanism.

2.3. Methods

Each participant received oral instructions before participating in the 8MST. The participants were informed that the goal was to complete a simulated end-to-end vascular anastomosis of the Dacron graft within 8 min and they would have to immediately stop at the sound of the alarm. Participants were further instructed that their surgical assistant would follow all direct instructions but would not act autonomously. After completion of the test, the anastomosis was excised by the assistant and saved for future review, allowing the remainder of the graft to be repetitively used for future tests.

Each 8MST was scored on three domains, the 8MST setup score included five categorical variables given 1-point each (placement of two corner sutures, inside-to-outside placement of corner sutures, back wall completed first, forehand suturing, and suturing toward the participant), the 8MST technical score was comprised of four categorical variables given 1-point each (pushes needle forward, even spacing and appropriate depth of sutures, gentle tissue handling, and knot tying) and a percentage of the anastomotic circumference completed in 8 min (0, 0.25, 0.50, 0.75 or 1), the 8MST total score was defined as the aggregate of the 8MST setup and 8MST technical score. The 8MST total score had a maximum value of 10 indicating the best possible performance.

2.4. Inter-relater reliability

The digital video recording was reviewed by two reviewers who independently assigned values according to the described scoring metric. One reviewer was a postgraduate year (PGY)-3 general surgery resident (R.W.D.), trained in the specifics of the evaluation methodology, and the other an attending hepatobiliary surgeon (T.A.A.). Each reviewer was blind to the other's scores until after all ratings had been completed and finalized. For statistical comparison of their performance, concordance or inter-rater reliability was measured based on these data.