



The reliability of multiple objective measures of surgery and the role of human performance

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Abstract

Background: There is a need for reliable and valid objective methods of technical skills in surgery. Six-bench surgical top stations have been combined to assess basic surgical trainees (BSTs) objectively. The current study examines its reliability and validity across repeat sittings.

Methods: Eleven surgical trainees (6 senior BSTs and 5 higher surgical trainees [HSTs]) undertook 5 sittings of the 6-station assessment designed to be completed within 90 minutes. The 6 stations consisted of knot tying, suturing, closure of enterotomy, excision of sebaceous cyst, laparoscopic task, and instrument examination. Methods of analysis employed were motion analysis, observation with criteria, and inbuilt simulation metrics.

Results: On analysis 3 knot tying and suturing stations exhibited significant differences in either time or movement; any difference was over by the second run. The intertest reliabilities were .66, .74, .55, .51, and .65 for the 5 runs. The intratest reliability across repeated sittings varied from .56 to .96. The inter-rater reliability for video assessment varied from .77 to .94.

Conclusion: The assessment is reliable and valid across repeated sittings. Its use in assessment of basic technical skills needs to be encouraged. © 2005 Excerpta Medica Inc. All rights reserved.

Keywords: Reliability; Objective assessment; Surgical trainees

The need for reliable and valid method of technical skills assessment in surgery has been driven by forces both within the surgical fraternity [1,2] and outside; these include high-profile cases such as those experienced in the Bristol pediatric cardiac service [3]. There is also concern regarding the standards of skills because of reduced hours and exposure for trainees [4,5], as well as the negative effect of new rotas and shifts and their consequence in a number of areas [6–10]. Overall, there is felt to be a deficiency of skills assessment in the United Kingdom [11,12]. This reduction in hours is occurring both in Europe, as a result of the European Working Time Directive, and in the United States, as a result of legislation. This comes in a system where progression is based on the passing of factual exam-

inations, and the operative and practical experience of candidates is highly varied [13–16].

There are now a number of objective methods to quantify surgical performance; these are both qualitative [17,18] and quantitative [19,20] or a combination of the two, often using virtual reality-based simulation [21–24].

These methods of analysis are designed for the laboratory setting on standardized models (although these methods may be used in the operative environment); hence, this assessment was conceived to run in the skills laboratory with a number of stations in an objective structured clinical examination (OSCE) type setting. These methods of analysis have been combined into a unique model entitled Multiple Objective Measures of Surgery (MOMS) [25], wherein its validity was established. The methods described were designed for the most junior of surgical trainees in the United Kingdom, the basic surgical trainees (BSTs) and the tasks contained within to function at a basic level. The

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assessment is divided into 6 stations each allotted 15 minutes and in combination designed to test the basic skills of surgery: knot tying, suturing, dissection, basic knowledge of task and instruments and eye-hand coordination via a basic laparoscopic task, thus assessing basic technical skills and cognition at an appropriate level. The tasks were based on components that are taught in the Basic Surgical Skills Course. This was piloted successfully, and continues to run at present. However, the reliability of the assessment and the effect of human performance on repeated sittings of the assessment have not been quantified. This report therefore aims to explore the issue of reliability and the effects of performance on these previously validated measures.

Materials and Methods

Subjects

Trainees were recruited to the skills laboratory to undertake 5 repeat sittings of the skills assessments. The assessment consisting of the 6 stations as listed, each allocated a maximum of 15 minutes, 90 minutes in total. Sittings were permitted at any convenient time, but there had to be at least 24 hours between sittings. The BSTs who undertook the assessment were expected to have sat and passed the Membership of the Royal College of Surgeons examination (or equivalent) and the higher surgical trainees (HSTs) to have at least 2 years experience at this level. In total 11 surgeons underwent repeat sittings; 6 of these were BSTs and 5 were HSTs, giving 55 sittings in total. The possibility of the spectrum of the trainees affecting the reliability was not explored as the original construct was defined in these 2 groups and it was postulated that in the short term there would be little learning effect.

Stations

Operative equipment and instrument examination

This station was divided into 2 areas: instruments and sutures and operating theater equipment. The instruments and sutures exercise consisted of 8 laminated sheets of life-size photographs of common sutures and instruments. The subject was given a choice of 4 objects for a given task and was expected to select the most appropriate. There were 8 questions with a maximum score of 8. The theater equipment section consisted of 2 commonly used pieces of theater equipment: a laparoflator (Storz Electronic endoflator 26430020; Storz, Tuttlingen, Germany) and diathermy machine (Storz Autocon 350 20523520). There were 8 questions related to the laparoflator, its dials, and safe use, and 9 questions related to the diathermy device, its set up, dials, and safe use. Therefore, there were a maximum of 25 marks available in this section, which was designed to be completed within 15 minutes. This exercise has been shown previously to exhibit construct validity. Although this sta-

tion examined a different construct from the other stations, it shows a close correlation with some of the of the technical tasks [26].

Knot tying station

Subjects were requested to tie 4 knots on an Ethicon knot-tying jig (Ethicon, Edinburgh, UK): 10 knots with cord at surface; 10 throws of 2/0 braided suture 45 cm 2/0 Polysorb ties (USSC, Connecticut, Norwalk, USA), at surface; 4 throws of cord at depth on jig; and 4 throws of 2/0 braided suture 45 cm 2/0 Polysorb ties (USSC) at depth on jig.

All knots were checked for squareness and orientation. Motion analysis of the task was carried out using an Imperial College Surgical Assessment Device (ICSAD) [20]. This is an electromagnetic tracking device that computes the number of hand movements made and the time taken for the procedure. Start and stop points were standardized, as was the position of the trackers on the dorsum of the hand.

Suturing station

Two standardized exercises of suturing were undertaken: 5 simple interrupted suture with 4 single instrument throws; and 5 interrupted vertical mattress sutures with 4 single instrument throws. These were undertaken on a Limbs and Things large skin pad (Bristol, UK) divided into 2, each half having two 4-cm incisions marked with suture points marked 1 cm apart and 1 cm either side of the incision, producing 5 points. The skin pads were mounted in a standardized fashion on a Limbs and Things skills board. The suture used was 3/0 polysorb (or equivalent) with a PC12–19 mm, $3/8$ circle needle. Motion analysis was performed measuring parameters of time taken and total number of movements. All knots again underwent scrutiny for correct orientation and being laid “square and flat.”

Closure of enterotomy task

This involved the closure of a 2-cm small bowel enterotomy using 2 stay sutures and interrupted seromuscular sutures as advocated on the Basic Surgical Skills Course. The synthetic model was a Limbs and Things double-layer 20-mm bowel; the enterotomy was closed using 3/0 absorbable suture on a 20-mm taper needle. The bowel was mounted on a Limbs and Things skills board. The participants were requested to hand tie all knots. The method for scoring was by the Objective Structured Assessment of Technical Skills (OSATS) method as developed in Toronto; however, this task was not scored live but digitized using a Sony DV camera (Sony, Tokyo, Japan) and reviewed in a blinded fashion by 3 independent reviewers at a later sitting. The scoring sheets consisted of a task-specific checklist and a global rating form.

Excision of sebaceous cyst task

This required the excision of a synthetic sebaceous cyst (Limbs and Things) using an elliptical incision, and the skin

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