Multi-Institutional Validation of an OSATS for the Assessment of Cystoscopic and Ureteroscopic Skills

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Abbreviations and Acronyms

CT = computerized tomography

GPSS = global psychomotor skills score

IRR = interrater reliability

OSATS = Objective Structured Assessment of Technical Skill

PGY = postgraduate year

TCS = total cognitive score

URS = ureteroscopy

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Purpose: We evaluated the internal and construct validity of an assessment tool for cystoscopic and ureteroscopic cognitive and psychomotor skills at a multi-institutional level.

Materials and Methods: Subjects included a total of 30 urology residents at Ohio State University, Columbus, Ohio; Penn Presbyterian Medical Center, Philadelphia, Pennsylvania; and Mayo Clinic, Rochester, Minnesota. A single external blinded reviewer evaluated cognitive and psychomotor skills associated with cystoscopic and ureteroscopic surgery using high fidelity bench models. Exercises included navigation, basketing and relocation; holmium laser lithotripsy; and cystoscope assembly. Each resident received a total cognitive score, checklist score and global psychomotor skills score. Construct validity was assessed by calculating correlations between training year and performance scores (both cognitive and psychomotor). Internal validity was confirmed by calculating correlations between test components.

Results: The median total cognitive score was 91 (IQR 86.25, 97). For psychomotor performance residents had a median total checklist score of 7 (IQR 5, 8) and a median global psychomotor skills score of 21 (IQR 18, 24.5). Construct validity was supported by the positive and statistically significant correlations between training year and total cognitive score ($r = 0.66$, 95% CI 0.39–0.82, $p = 0.01$), checklist scores ($r = 0.66$, 95% CI 0.35–0.84, $p = 0.32$) and global psychomotor skills score ($r = 0.76$, 95% CI 0.55–0.88, $p = 0.002$). The internal validity of OSATS was supported since total cognitive and checklist scores correlated with the global psychomotor skills score.

Conclusions: In this multi-institutional study we successfully demonstrated the construct and internal validity of an objective assessment of cystoscopic and ureteroscopic cognitive and technical skills, including laser lithotripsy.

Key Words: urinary bladder, ureter, endoscopy, psychomotor performance, internship and residency

In urology training programs technical skills assessments are subjective and operative experience can vary.[1] Progression through residency to board certification depends on passing written and oral examinations, and

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not demonstrating technical competency. Skills testing using actual patients is difficult to standardize. Fortunately skills assessment using low fidelity endourology bench models has been found to correlate well with actual operative skill.[2]

OSATS was initially developed for general surgery by Reznick et al.[3] Trainees completed a series of surgical tasks using bench models while being assessed by experienced surgeons with an operation specific checklist and a global performance rating score. OSATS provides a periodic assessment of trainee technical abilities and shortcomings as well as a demonstration of procedure specific competency at the completion of training. Some surgical specialties are considering using OSATS as a potential requirement to demonstrate technical competency prior to board certification.[4]

If skills assessments are to be used in any capacity that influences professional advancement or certification, they require rigorous evaluation to ensure reliability and validity. Establishing the validity of a testing instrument determines the trustworthiness of the results obtained and sets the stage for wider use. Construct validation is an important component of validation. In the literature that addresses resident evaluation construct validity can be claimed when a test differentiates performance based on year of training and/or level of experience.[5,6]

We previously described and validated an OSATS for the assessment of endourological skills at our institution.[7] However, it has not been externally validated. In this multi-institutional study we examined the construct and internal validity of an OSATS to assess cystoscopic and ureteroscopic skills.

MATERIALS AND METHODS

Development of OSATS for Endourology

Two subject matter experts (RMS and MM) performed task deconstruction of the skills necessary to safely and successfully perform cystoscopy and ureteroscopy.[8] Based on this an OSATS for endourology was designed to assess cognitive and psychomotor skills.

Data Collection

After providing informed consent urology residents rotated through a series of cognitive and psychomotor exercises while scores were recorded by an observer (OBA) blinded to resident PGY and experience level. Participants were from a total of 3 institutions, including Ohio State University, University of Pennsylvania and Mayo Clinic. Data collected included year of training, demographic data and potential confounding factors (handedness, and past musical, video gaming and simulation experience). Residents were asked to classify themselves into experience groups based on the number of ureteroscopic cases performed, including 0 to 10, 10 to 30, 30 to 50, 50 to 75 and 75 to 100.

Cognitive Skills Module

The cognitive module consisted of a series of stations where residents answered a variety of questions (written multiple choice, true/false and oral). Test questions were created by the subject matter experts to assess critical cognitive aspects of cystoscopy and ureteroscopy. Each station consisted of a presentation of a variety of endourological instruments, such as scopes, baskets, dilators, wires, sheaths, stents, etc, with questions based on the identification, selection and indications for use of each instrument. Decision making and preoperative planning skills were also evaluated using case studies. Residents were asked to select the appropriate equipment needed to perform different ureteroscopic cases. Additionally, they were asked to label a schematic diagram of the ideal operating room setup for ureteroscopy. Examples of broken ureteroscopic equipment were also demonstrated and participants were evaluated on the ability to identify and troubleshoot the problem. Cognitive tasks were scored by content category and a TCS was calculated for each participant with a maximum score of 132.

Bench Models for Psychomotor Assessment

Psychomotor skills were assessed using high fidelity organosilicate bench models simulating the upper urinary tract (fig. 1). These patient specific, anatomically correct models were derived from 3-dimensional CT reconstructions. They were composed of a proprietary organosilicate recipe with realistic color mapping of urinary tract and calyces, and physical properties based on human tissue (fig. 2).

Psychomotor Skills Module

The psychomotor skills module consisted of 3 exercises, including 1) navigation, stone basketing and stone relocation; 2) holmium laser lithotripsy; and 3) cystoscope assembly. Psychomotor exercises were supervised by qualified surgeons at each home department, although faculty members were not allowed to coach or teach candidates. To ensure consistency the same bench models, ureteroscopes and cystoscopes were used at each institution. Psychomotor skills were assessed based on procedure specific checklists as well as with a subjective GPSS with a minimum score of 7 and a maximum score of 35 (figs. 3 and 4).

Station 1: Navigation, Basketing and Relocation Exercise. Residents were shown actual patient CT images and instructed that the patient had a 1 cm stone located in a lower pole calyx. Using a flexible ureteroscope residents were instructed to access the kidney through the ureter, navigate all calyces and locate the stone in a posterior lower calyx. They were then instructed to use a nitinol stone basket to relocate the lower calyceal stone to the upper pole. Completion of individual steps and total time were recorded using a procedure specific checklist (fig. 3). Additionally, for the basketing step efficiency/error metrics were tracked, including the number of basketing attempts and the number of accidental stone drops.