Validation of a High Fidelity Adult Ureteroscopy and Renoscopy Simulator

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Purpose: Surgical simulation technology may efficiently train and accurately assess the acquisition of many skills. Surgical simulators often lack realism and can be expensive at $3,000 to more than $60,000. We assessed the face, content and construct validity of a newly developed, anatomically accurate, reasonably priced high fidelity ureteroscopy and renoscopy trainer.

Materials and Methods: A total of 46 participants, including attending urologists, urology residents, medical students and industry representatives, assessed the face and content validity of the simulator using a standard questionnaire. Ten experienced ureteroscopists with greater than 30 procedures per year and 10 novice ureteroscopists with 0 were assessed on the ability to perform flexible ureteroscopy, renoscopy and intrarenal basket extraction of a lower pole calculus using the adult ureteroscopy trainer (Ideal Anatomic Modeling, Holt, Michigan). Subject performance was assessed by an experienced ureteroscopist using a checklist, global rating scale and time to task completion.

Results: Of participants 100% rated the trainer as realistic and easy to use, and thought it was a good training tool, 98% thought that it would serve as a good training format and 96% would recommend it to urology trainees. All participants recommended it for use in residency programs and 96% would or would have used it during residency. Only 37.5% vs 100% of experienced vs novice ureteroscopists would use it to practice. Of participants 9% foresaw a problem with the trainer. On the trainer experienced ureteroscopists scored significantly higher on the global rating scale (mean $\pm$ SD 33.1 $\pm$ 1.3 vs 15.0 $\pm$ 2.7, $p < 0.0001$) and checklist (4.1 $\pm$ 1.0 vs 2.4 $\pm$ 1.1, $p = 0.004$), and required less time to complete the task (141.2 $\pm$ 40.1 vs 447.2 $\pm$ 301.7 seconds, $p = 0.01$).

Conclusions: Our preliminary study suggests the face, content and construct validity of the adult ureteroscopy trainer as a high fidelity ureteroscopy and renoscopy trainer.

Key Words: ureter, kidney, ureteroscopes, computer simulation, medical education

In the last decades the applications of endoscopic techniques have expanded and minimally invasive techniques in urology have spread rapidly, as has the concomitant need for training and qualification in the complicated techniques. There is growing realization that a large part of the learning curve of procedures does not necessarily require practicing on patients and it may be better to train on a model first.[1] Also, fiscal constraints and eth-

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ical concerns in regard to residents learning on patients have led surgical educators to pursue alternative means of educating trainees. Skills laboratories allow surgical residents to practice surgical techniques on bench models in a laboratory environment with the goal of preparing them for the operating room.[2–6]

Models of basic endourological procedures such as cystoscopy and ureteroscopy are among the most commonly used and studied simulation types.[7] There are various types of simulators, including low and high fidelity, and virtual reality trainers.[1] They often lack realism and can be expensive at $3,000 to more than $60,000. Educational institutions have finite resources and some do not have funds to purchase the more expensive trainers available. A new high fidelity ureteroscopy and renoscopy trainer, the adult ureteroscopy trainer, was recently introduced by a urology resident. It is claimed that this model has affordability, durability and anatomical accuracy. We assessed the face, content and construct validity of this newly developed high fidelity simulator.

MATERIALS AND METHODS

The adult ureteroscopy trainer was created using the upper urinary tract of a patient who had difficulty spontaneously passing renal calculi. Data on patient computerized tomography were processed and an exact replica of the collecting system was created using rapid prototyping (fig. 1). Rapid prototyping takes virtual designs from animation modeling software, transforms them into thin, virtual, horizontal cross sections and creates each cross section in physical space one after the next until the model is finished. The model was cast into a durable silicone mold to create the simulator (fig. 2).

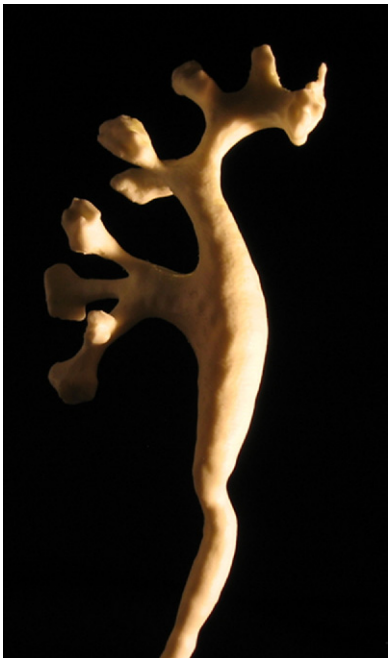

Figure 1. Right renal collecting system model created by rapid prototyping.

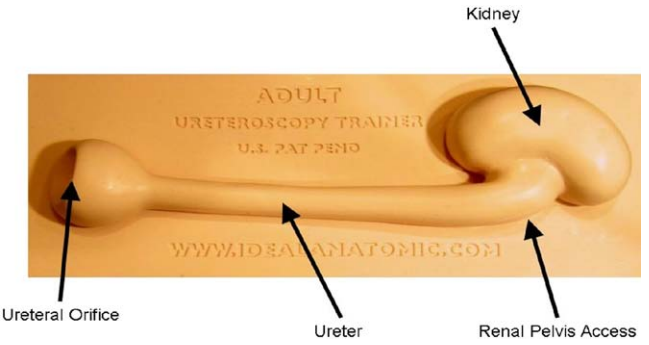

Figure 2. Adult ureteroscopy trainer

After receiving institutional review board approval the simulator was taken to the 2007 American College of Osteopathic Surgeons Urological Discipline mid-year meeting in Traverse City, Michigan. At the meeting the trainer was assessed by 46 participants, including 19 attending urologists, 11 urology residents, 10 medical students and 6 biotechnology industry representatives. A standardized questionnaire was used to determine surgical training and experience. Each participant performed ureteroscopy and renoscopy on the trainer, and completed another standard questionnaire to assess simulator face and content validity.

The questionnaire assessed anatomical accuracy, similarity to ureteroscopic images and ease of use. Participants were also asked whether they thought the trainer was a good practice format and whether they would use it to practice. In regard to residency training participants were asked whether they thought the trainer was a good training format, whether it should be made available to residents and whether they would or would have used it during residency. They were asked whether they foresaw any potential problems with trainer use.

Additional institutional review board approval was obtained in fall 2008 at Metro Health Hospital to measure simulator construct validity. Two groups were assigned based on ureteroscopic experience, including group 1—10 participants who performed greater than 30 procedures per year and group 2—10 who had never performed ureteroscopy. Each participant was required to perform flexible ureteroscopy and renoscopy with stone basket extraction of a lower pole calculus. The lower pole was chosen because it requires active and passive ureteroscope deflection to achieve entry to the calix. Group 2 participants were given a standard introduction to the ureteroscope, including handling, tip manipulation and basket extraction, before beginning the task.

A single experienced, unblinded ureteroscopist used a global rating scale and ureteral checklist to evaluate participants. The scale and checklist, adapted from Matsumoto et al,[8] were modified to account for the absent bladder and urethra on the simulator. The evaluator assigned each of the 6 tasks on the ureteral checklist a score of