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Development and Validation of a Novel and Cost-Effective Animal Tissue Model for Training Transurethral Resection of the Prostate ☆

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OBJECTIVES: To develop and validate a new and cost-effective animal tissue training model for practicing resection skills of transurethral resection of the prostate (TURP).

METHODS AND MATERIALS: A porcine kidney was prepared and restructured to simulate the relevant anatomy of the human prostate. The restructured prostate was connected to an artificial urethra and bladder. Face, content, and construct validity of the model was carried out using a 5-point Likert scale questionnaire, and comparison in task performance between participants and experts was made using observational clinical human reliability analysis.

RESULTS: A total of 24 participants and 11 experts who practiced TURP skills on this model from October 2014 to December 2015 were recruited. The mean score on specific feature of the anatomy and color, sensation of texture and feeling of resection, conductibility of current, and efficacy and safety of the model were 4.34 ± 0.37, 4.51 ± 0.63, 4.13 ± 0.53, and 4.35 ± 0.71, respectively, by participants whereas they were 4.22 ± 0.23, 4.30 ± 0.48, 4.11 ± 0.62, and 4.56 ± 0.77, respectively, by the experts on a scale of 1 (unrealistic) to 5 (very realistic). Participants committed more technical errors than the experts (11 vs 7, $p < 0.001$), produced more movements of the instruments (51 vs 33, $p < 0.001$), and required longer operating time (11.4 vs 6.2 min, $p < 0.001$).

CONCLUSIONS: A newly developed restructured animal tissue model for training TURP was reported. Validation study on the model demonstrates that this is a very realistic and effective model for skills training of TURP. Trainees committed more technical errors, more unproductive movements, and required longer operating time. (J Surg Ed ■:■■■-■■■. © 2017 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: animal tissue model, simulation training, training model validity, transurethral resection of the prostate (TURP)

COMPETENCIES: Practice-Based Learning and Development, Medical Knowledge, Patient care

INTRODUCTION

Transurethral resections of the prostate (TURP) is one of the essential competencies for participants to master before completing urological training.[1] Like any endoscopic procedures, it requires trainees to perform hundreds of procedures to reach proficiency.[2] However, the reduction of working hours introduced by the European working time directive has significantly reduced trainees' surgical training time,[3] and the developments in medical therapy for benign prostatic hyperplasia have resulted in fewer TURPs being performed.[4] These changes in surgical practice together have resulted in the current trainees performing less TURPs.[3,4] To find a solution to overcome these limitations, both participants and specialists have explored the use of simulation as a method of safe and effective urology training.[5,6] A program of simulation training for technical and

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nontechnical skills has been implemented in a pioneering training centers.[7]

Virtual reality simulators have been proven a valid method for training in TURP, and a number of systems have been developed and used for this purpose.[8-11] The advantages of virtual reality simulators are that they are able to simulate prostates of different size, shape, and grade of difficulty. They can simulate bleeding during practice and also provide feedback by automatically measuring the performance.[9-11] However, these systems have a shortcoming in common in that they are very expensive, and some of them do not have tactile feedback or only have some unrealistic tactile feedback. Some virtual reality simulators have been proven to be in need of modification.[12] In addition to this, a commercially available physical synthetic model has been developed and validated.[13]

Animal training models have been widely used for surgical skills training in other endoscopic procedures.[14-17] However, there is no existing animal prostate suitable for TURP training. Human cadavers have been used for TURP training in some training centers, and it has been demonstrated that it is feasible, acceptable, and high value for surgical training.[18,19] However, this is a very precious resource, and it is not always possible to get access to them.[18,19] Therefore, it is worth exploring an effective alternative by designing a restructured animal tissue model to simulate prostates for training in TURP as having been developed in other surgical specialities.[15,20]

When designing and developing such a model, the following factors can be considered[21,22]: (1) the model may be as realistic as possible to simulate the anatomy and pathology involved in the procedure; (2) skills learned on this model may be transferable to the operating theater; (3) the final result of the performance can be made available for inspection and feedback; (4) it may have the ability to distinguish the experience of surgeons; and (5) it may also be cost-effective to produce and simple enough to be massively reproduced for a group of participants and routine use for practice.

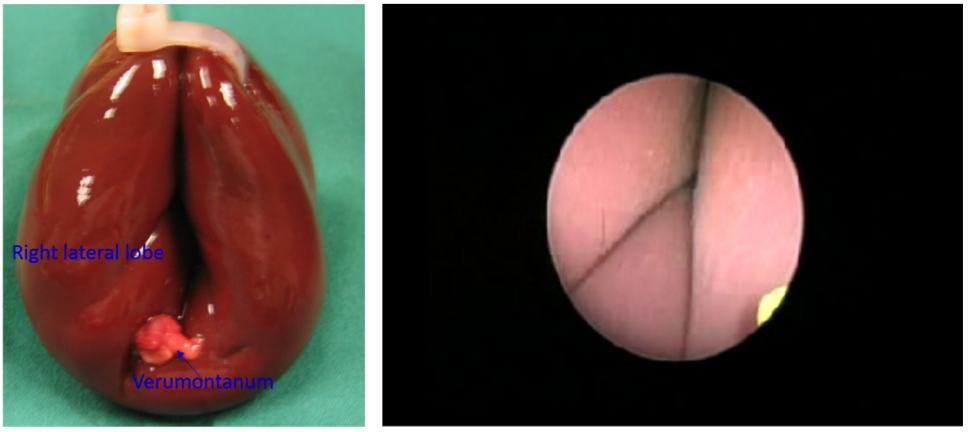
A model developed has to be realistic, appropriate, and effective as a teaching and training tool, and it also should have the ability to distinguish surgeons' experience. Thus, validation of reliability and effectiveness remains critical.[23-26] The aim of this study was to describe the details of how to make such a training model for TURP and to conduct face, content, and construct validity of the model.

METHODS AND MATERIALS

Design and Preparation of the Restructured Animal Tissue Model of TURP

Porcine kidneys weighing 50 to 70 g were obtained. A restructured prostate made from a kidney of this size was similar to the size of an enlarged human prostate. These kidneys were collected from a local abattoir that was fully registered under the standard regulations stipulated by the meat industry and follows strict ethical guidelines. The porcine kidney could also be bought from the meat counter in the local supermarkets for 1 box of 6 for £2.90. The cost of making a complete model was approximately £80, which included labor and materials. This porcine kidney prostate portion of the model was mounted in a reusable latex portion of the model. Once the latex portion of the model is made, it was used for many years.

Close supervision and instruction were provided by an experienced consultant urologist during the restructuring process. A piece of renal vessel was prepared and sutured onto the middle center to simulate the verumontanum of the prostate (Fig. 1A). Two light cuts were made on the back of the kidney to allow it to sit better on the base, and a cable tie was used to tie the 2 ends of the kidney loosely together to form the shape of 3 lobes of a prostate (Fig. 1B, an endoscopic view of the model). A piece of tin foil was wrapped around the prostate model to enable the use of monopolar electrosurgery. The isolated system of electro-



A. Apex of the prostate

B. An endoscoopic view of the restructtured prostaate

FIGURE 1. Simulation of the verumontanum and the lobes of a prostate were developed by suturing a piece of tissue in the front of the folded kidney (A). An endoscopic view of the restructured prostate model after the kidney has been mounted within the latex urethral and bladder model (B).