

Surgery in Motion

Results of the European Basic Laparoscopic Urological Skills Examination

Willem M. Brinkman^{a,*}, Irene M. Tjiam^a, Barbara M.A. Schout^{b,c}, Arno M.M. Muijtjens^d, Ben Van Cleynenbreugel^e, Evert L. Koldewijn^{a,d}, J. Alfred Witjes^f

^aDepartment of Urology, Catharina Hospital Eindhoven, The Netherlands; ^bDepartment of Urology, Medical Centre Alkmaar, The Netherlands; ^cEMGO Institute, VU Medical Centre Amsterdam, The Netherlands; ^dDepartment of Educational Development and Research, FHML, Maastricht University, The Netherlands; ^eDepartment of Urology, Catholic University Hospital of Leuven, Belgium; ^fDepartment of Urology, Radboud University Nijmegen Medical Centre, The Netherlands

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Abstract

Background: In 2011, the European Basic Laparoscopic Urological Skills (E-BLUS) examination was introduced as a pilot for the examination of final-year urologic residents. **Objective:** In this study, we aimed to answer the following research questions: What level of laparoscopic skills do final-year residents in urology have in Europe, and do the participants of the E-BLUS pass the examination according to the validated criteria? **Design, setting, and participants:** Participants of the examination were final-year urology residents from different European countries taking part in the European Urology Residents Education Program in 2011 and 2012.

Surgical procedure: The E-BLUS exam consists of five tasks validated for the training of basic urologic laparoscopic skills.

Outcome measurements and statistical analysis: Performances of the tasks were recorded on DVD and analysed by an objective rater. Time and number of errors made in tasks 1–4 were noted. Furthermore, all expert laparoscopic urologists were asked to score participants on a global rating scale (1–5) based on three items: depth perception, bimanual dexterity, and efficiency. Participants were asked to complete a questionnaire on prior training and laparoscopic experience.

Results and limitations: Seventy DVD recordings were analysed. Most participants did not pass the time criteria on task 4 (90%), task 2 (85.7%), task 1 (74.3%), and task 5 (71.4%). Task 3 was passed by 84.3%. The overall quality score was passed by 64%. When combining time and quality, only three participants (4.2%) passed the examination according to the validated criteria. According to the questionnaire, 61% did not have the opportunity to train in laparoscopic skills.

Conclusions: The results of the E-BLUS examination show that the level of basic laparoscopic skills among European residents is low. Although quality of performance is good, most residents do not pass the validated time criteria. Regular laparoscopic training or a dedicated fellowship should improve the laparoscopic level of residents in urology.

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* Corresponding author. Department of Urology, Catharina Hospital Eindhoven, Michelangelolaan 2, 5623 EJ Eindhoven, The Netherlands. Tel. +31 617 644 434.
E-mail address: wmbrinkman@gmail.com (W.M. Brinkman).

1. Introduction

Despite the growing popularity of robot-assisted laparoscopy in urology, conventional laparoscopic surgery is still the

established technique for several indications [1] throughout Europe. Many of the laparoscopic procedures have a lengthy learning curve, because laparoscopy requires other skills than open surgery and robot-assisted laparoscopy, such as

counterintuitive movements of the instruments and an indirect view of the operating site [2,3]. There is a recognised need for a more formalised laparoscopic training framework within urology to overcome the difficulties of this technique and to shift the first part of the learning curve from the patient to the skills laboratory. Therefore, simulator-based skills training has been widely accepted and implemented [4].

However, the qualification and certification of laparoscopic skills performance are still in a preliminary phase within urology. In response to urgent calls from the government and the public for well-defined proficiency standards to safeguard the quality of care, we developed the program for laparoscopic urologic skills (PLUS) [5,6]. The PLUS has been validated by a cohort of laparoscopic experts, intermediates, and novices in the Netherlands, and its face, content, and construct validity have been proven. The PLUS examination offers quality criteria and time criteria for the completion of basic laparoscopic tasks and a certification standard for residents based on the generalized examinee-centred method. The pass/fail criteria for time and quality of performance per task were set on the novice/intermediate boundaries [6]. In the Netherlands, PLUS has recently been implemented at the national level as a “basic laparoscopy examination.”

In 2011, the PLUS was introduced at the European level as a pilot for the examination of final-year urologic residents. It is called the European Basic Laparoscopic Urologic Skills (E-BLUS) examination.

In this study, we aimed to answer the following research questions: What level of laparoscopic skills do final-year residents in urology in Europe have, and do participants of the E-BLUS pass the examination according to the previously validated criteria?

2. Method

2.1. Setting

The E-BLUS examination was conducted during the laparoscopic hands-on training (HOT) section of the European Urologic Residents Education Programme (EUREP) meetings in 2011 and 2012. EUREP is organised annually by the European School of Urology (ESU) in collaboration with the European Board of Urology and has been developed exclusively for European residents. Participation in the E-BLUS examination was facilitated by prior online registration on a voluntary basis. All participants were advised to attend an HOT session prior to the examination in which they could familiarise themselves with the exercises.

2.2. Materials

The E-BLUS examination consists of five tasks (Fig. 1). With these tasks, the examination assesses bimanual dexterity, hand-eye coordination, spatial awareness, suture technique, and clipping and cutting skills. All participants in the study used identical boxes, tasks, suture material (Polysorb 3-0, Tyco Healthcare, Mansfield, MA, USA), Hem-o-lok appliers (Teleflex Medical, Research Triangle Park, Durham, NC, USA), and laparoscopic instruments (Olympus, Hamburg, Germany). The five tasks shown in Figure 1 have been previously described in the validation study

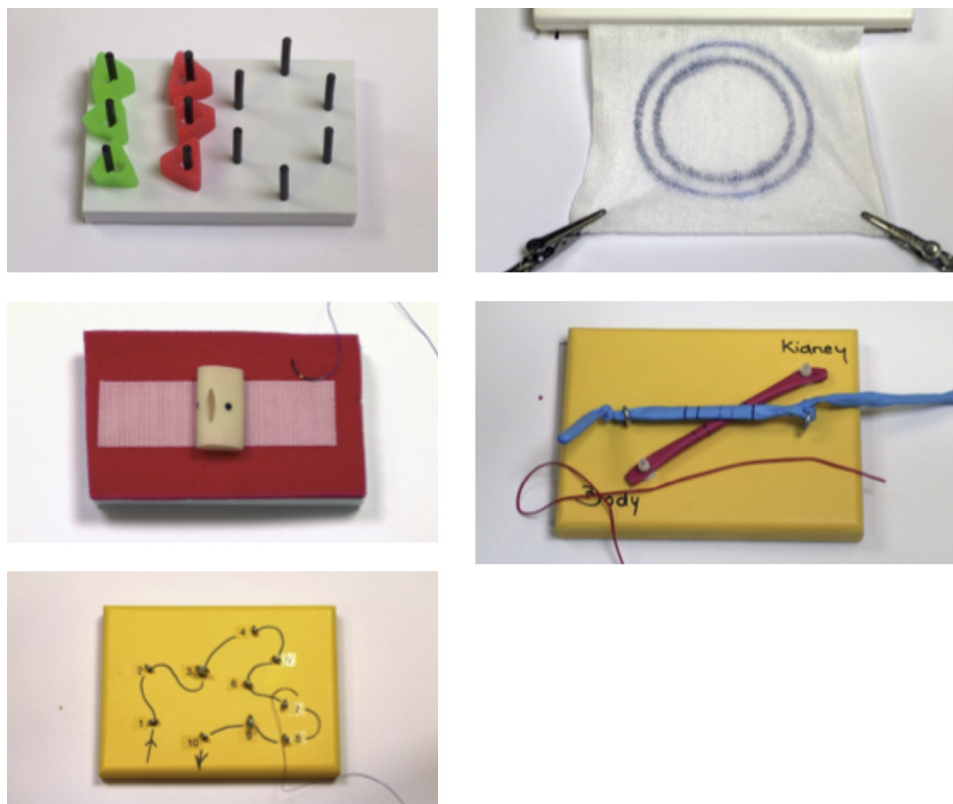


Fig. 1 – The European Basic Laparoscopic Urological Skills tasks. The examination consists of five basic laparoscopic tasks in a box trainer with a fixed camera position.

Table 1 – Binominal checklist used for the evaluation of quality

	Trial 1	Trial 2
Task 1	No. of dropped objects*	
Task 2	Cut between the lines? (yes or no)	
Task 3	Suture is placed within 1 mm or through the dots? (yes or no)	
	The knot holds (does not slip)? (yes or no)	
	The knot keeps approximation of the tissue? (yes or no)	
Task 4	Three clips are placed on both tubes? (yes or no)	
	All clips all placed within 1 mm of the line? (yes or no)	
	All cuts are placed between the dotted lines? (yes or no)	
Total quality score (accumulation of answer yes)		
* Number of objects was counted but equal to the validation study of Tjiam et al. [5,6] not included in the overall quality score.		

of Tjiam et al. [5,6], who established face, content, and construct validity and determined test criteria.

Time and quality were measured for the tasks. To judge the quality, we used a binominal 14-item checklist covering the quality parameters. For each error, a score of 0 was applied. Target overall quality score was 11 out of 14 (Table 1).

In summary, the following task descriptions, error criteria, and target scores were used:

- Task 1: Peg transfer. Six plastic objects are grasped, transferred to the opposite forceps, placed on a pegboard, and vice versa. The number of dropped objects was counted. The target time was 112 s. This task required two dissectors.
- Task 2: Pattern cutting. A circle is cut from gauze between two premarked lines. A cut beyond the outer or inner line of the circle is scored as an error. The target time was 118 s. This task required a dissector and a pair of scissors.
- Task 3: Single knot tying. An intracorporeal knot is made on a Penrose drain. A stitch beyond 1 mm of the black dots, a gap in the slit of the Penrose drain, or a slipping knot was scored as an error. The target time was 283 s. This task required two needle holders.
- Task 4: Clip and cut. Hem-o-Lok clips are placed around two tubes, and the tubes are cut. One of the clips placed outside of 1 mm of the continuous line or a cut beyond the dotted lines was scored as an error. The target time was 251 s. This task required two dissectors, a pair of scissors, and a Hem-o-Lok applier.
- Task 5: Needle guidance. A needle is guided through 10 metal rings following a set route. The target time was 218 s. This task required two needle holders.

Participants were allowed to practise each task for 1 min prior to the examination and had to perform the exercise twice during the examination.

2.3. Instruments

The pass/fail standard of the examination based on time and quality of performance was derived from the publication of Tjiam et al. [6] and based on the generalized examinee-centred method described by Cohen et al. [7]. This educational approach uses the linear relationship between

assessment scores and degree of procedural experience of multiple reference groups. The pass/fail scores were set as described by Tjiam et al.—that is, on the boundaries between the categories of novices (0 laparoscopic procedures performed) and intermediate experience in laparoscopy (between 1 and 100 procedures performed)—as a starting point for residents' further competency development towards the intermediate and expert levels.

Before the start of the examination, each participant was instructed by an expert laparoscopic urologist who had attended a teach-the-teacher course. The teach-the-teacher course focused on the background of the examination, the criteria, and the explanation the examinees were to receive during the examination. Performance was measured by recording time with a stopwatch and registering the number of errors made in tasks 1–4. Furthermore, all expert laparoscopic urologists were asked to score participants on a global rating scale (1–5) based on three items: depth perception, bimanual dexterity, and efficiency.

To minimise the effect of interrater differences, each task was recorded by digital video and saved for rating by independent raters. Ten DVD recordings were rated by two researchers to check whether the rater reliability were sufficiently high to allow a single rater. Classical approaches estimate reliability by measuring inter- and intraexaminer reliability, but weaknesses of these approaches are that new data must be generated to test each source of error. Moreover, when an error is identified, it is not compared with other sources of error, nor do these approaches assess to what extent the results are affected when errors interact. For example, reliability estimated by the relation between performer and other examiners (inter rater reliability) does not address reliability estimated by interaction between performer and exercise. To avoid these weaknesses, we applied the generalizability theory. This theory comprises a regression technique that models and quantifies relationships between variables to make predictions about reliability. In the current study, the generalizability analysis included the variance components for *performer*, *examiner*, and the interaction *performer x examiner*. The generalizability coefficient was measured on a scale of 0 to 1.0, where 0 was the lowest reliability and 1.0 was perfect reliability [8]. The generalizability coefficient for two video observers for time was near perfect ($G > 0.99$) for all five tasks. Therefore, the data of a single rater were used for further analysis.

2.4. Questionnaire

At the end of the examination, each resident was asked to complete a questionnaire (Fig. 2). This questionnaire consisted of three sections. The first section concerned demographics and postgraduate year of training, and the second section covered experience in actual laparoscopic procedures. In the third section, the residents were asked how many hours they had trained in laparoscopic skills in the 4 wk prior to the examination, whether there was a skills laboratory in their hospital, whether laparoscopic simulation devices were available, and whether they had ever attended a laparoscopic HOT course before the EUREP.

2.5. Outcome measures

The primary end point was to compare the results of the examination with the validated criteria. The secondary end point was to determine whether a relationship existed between laparoscopic skills and the participants' previous laparoscopic experience and training.

2.6. Statistical analysis

Statistical analysis was performed with SPSS version 18 software (IBM Corp., Armonk, NY, USA). Regression analysis used exam results as

dependent variables and the variables in the questionnaire as independent variables. The statistical significance of a regression coefficient was tested by a *t* test, considering a result statistically significant if $p < 0.05$.

3. Results

In total, 104 participants from 20 different countries completed the exam in 2011 and 2012. We analysed all the available DVD recordings of their performances ($n = 70$). Because no video recordings of the other 34 participants were available, we excluded them from analysis. The mean age of the participants was 31 yr of age (range: 26–40), and the mean year of residency was 5 (range: 2–6).

Of the included participants, the majority did not pass the time criteria on task 4 (90.0% failed), task 2 (85.7% failed), task 1 (74.3% failed), and task 5 (71.4% failed). Participants scored better on task 3, the intracorporeal suturing exercise, than on the other exercises. This exercise was passed in time by 84.3% of the participants. Forty-five of 70 participants (64.3%; Fig. 3) passed the quality of all exercises. Only three participants (4.2%) passed the combination of time and quality criteria.

According to the questionnaire results, 65% of the participants did not have a skills lab in their hospital, and 61% did not have the opportunity to train in laparoscopic skills. Also, 61% declared that they had not trained in basic

Questionnaire E-BLUS assessment EUREP

-Your responses will be processed anonymously-

Number:

Age:.....

Country:

Year of residency:

Describe your residency program: (Example: in the Netherlands the urology curriculum is 6 years in total: 2 years general surgery and 4 years urology)

.....

Questions considering laparoscopic experience

How many laparoscopic operations did you perform independent with or without supervision?

(Please write down the number per procedures below)

- Lap. Cholecystectomy: _____
- Lap. Appendectomy: _____
- Lap. Hernia Inguinalis repair: _____
- Lap. Hemicolectomy: _____
- Lap. Nephrectomy: _____
- Lap. Partial Nephrectomy: _____
- Lap. Pyeleoplasty: _____
- Lap. Lymph Node Dissection: _____
- Lap. Orchidectomy: _____
- Lap. Prostatectomy: _____
- Lap. Cystectomy: _____
- Lap. Adrenalectomy: _____
- Other: _____

Fig. 2 – The questionnaire on prior training and laparoscopic experience.

Questions considering training facilities

1. Does your hospital have a skills laboratory? Yes/ No

2. Does your hospital provide facilities for training laparoscopic skills? Yes/No
(If "No", please continue with question 5)

3. What kind of simulators does your hospital provide?

Box-trainer

VR-simulator

Other _____

4. How many hours have you trained laparoscopic skills in the past 4 weeks? _____ h

5. Have you ever attended a hands-on laparoscopic skills course before the EUREP Yes/No
If yes, when and where:

6. Other Comments

- Thank you for your response! -

Fig. 2. (Continued).

laparoscopic skills in the 4 wk prior to the examination. The European final-year urology residents performed a median of four laparoscopic procedures during their residency, including previous general surgery laparoscopic experience.

Global rating scores scored by the expert laparoscopic urologists were on average 3.6 on depth perception (range: 1–5), 3.7 on dexterity (range: 2–5), and 3.5 on efficiency (range: 1–5). For participants who had previously attended HOT courses, the global rating score was found to be significantly higher (difference: 0.3; *t* test, *p* < 0.05). A participant's previous training and experience did not affect the time scores nor the quality scores obtained at the examination.

4. Discussion

The first results of the E-BLUS examination showed that the majority of participants did not meet the E-BLUS criteria. Few final-year residents passed the examination according to the validated criteria. Results of the questionnaire revealed that overall training experience was limited and that most participants had not trained prior to the examination. Also, final-year residents in urology appeared to have limited exposure to actual laparoscopic procedures.

The scores may be relatively low for different reasons. One reason could be that the criteria set in previous

research by Tjiam et al. [6] were too strict, but this does not seem likely. We know from literature on the Fundamentals of Laparoscopic Surgery examination that most novice participants can reach even strict criteria based on expert scores and that it is a matter of training effort [9]. This is not surprising and can be explained by Ericsson's theory that deliberate practice is the most important ingredient for developing expertise [10]. The PLUS criteria are set on the boundaries of novices' and intermediates' performances and were intended not to be extremely difficult.

Another reason could be that participants may not have been capable or sufficiently prepared. We think that the results of the questionnaire explain why participants failed to meet the criteria. The low level of experience in laparoscopic procedures of the final-year residents had not been compensated by regular basic skills training. Most of them had not trained at all in the 4 wk prior to the exam or had not even been able to practice basic skills in their hospital.

The suturing task was performed relatively well within time. This is an interesting finding, because laparoscopic suturing is supposed to be one of the most challenging laparoscopic skills. Previous research on the EUREP meeting confirmed the appropriate level of suturing, especially among more experienced residents [11]. This finding can be explained by the fact that the residents were generally able

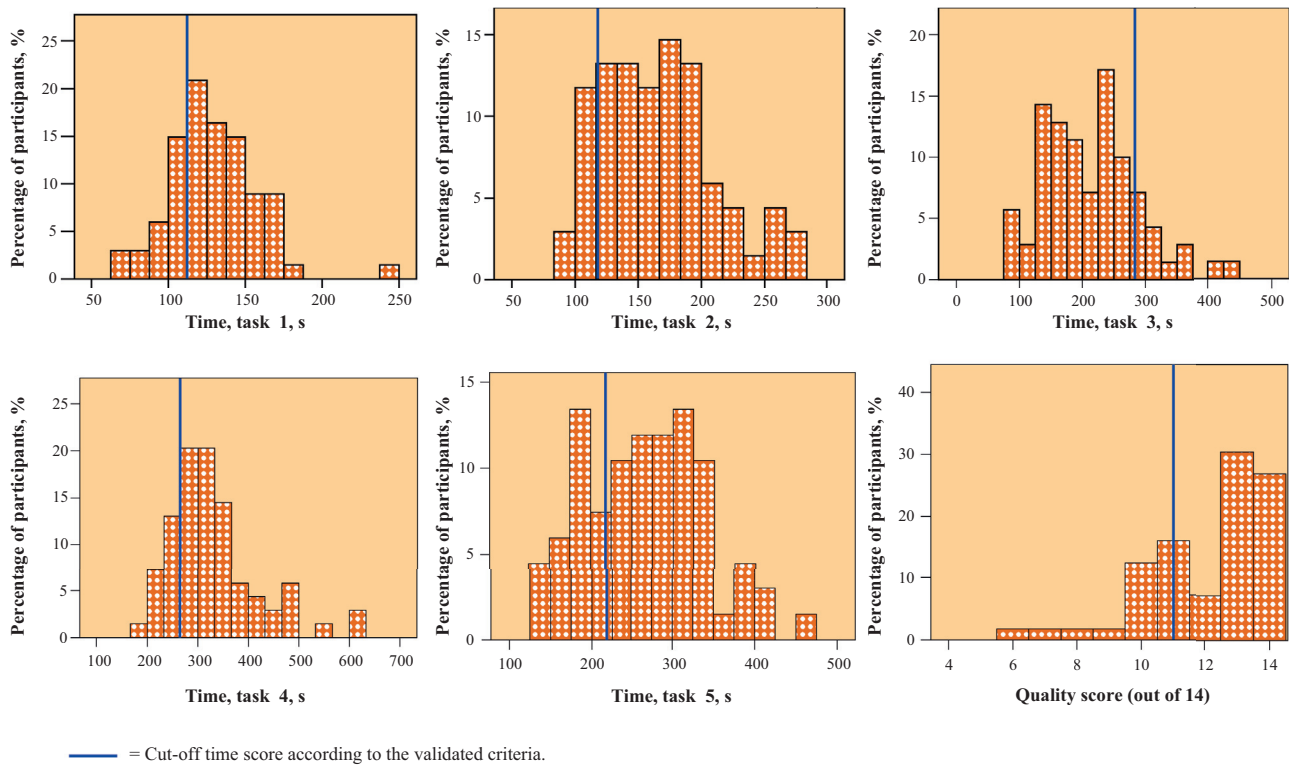


Fig. 3 – Graphs of all participants' scores on separate tasks and the overall quality score compared with validated criteria.

to perform the laparoscopic tasks, which indicates that they were not clumsy or incompetent, but because they were not sufficiently trained or experienced, performing the tasks within the time limit was the main issue. The time criteria for the suturing task were not set so strictly, because the criteria of the PLUS were based on a generalized examinee-centred method based on the boundaries between novices and intermediates, and suturing is considered a challenging skill even for laparoscopists with intermediate experience. Therefore, the criteria of the suturing task seem to be strict on quality rather than on time. This may explain why residents scored relatively better on this task. The overall quality score, which was good for most participants, confirms that they scored better on quality of performance than on time for all tasks. This is also in line with the global rating scores they received from the expert laparoscopic urologists.

The question these results raise is whether it is really necessary to speed up the basic laparoscopic skills and whether a good performance on quality is not more important in a clinical setting. The phases of learning a new motor skill have been described previously [12]. The first phase is on quality and accuracy, while speed and time are emphasised in a second phase, and, finally, time-sharing is introduced to obtain full automaticity of the skill. The participants of the E-BLUS examination performed relatively well on accuracy and quality, but they need more practice to increase their speed before they reach automaticity in these skills. In our opinion, not passing the time criteria means that these participants were not close to automaticity, yet. By acquiring basic skills and training these skills to

automaticity in a preclinical setting, residents can concentrate on the performance of the actual procedure and on all the procedural steps in the operating room. By intensifying basic laparoscopic skills training, a larger part of the learning curve of laparoscopic surgery can be shifted from the patient to the skills laboratory. The training in the operating room can subsequently be used for time-sharing tasks, such as dealing with procedural steps, difficult anatomy, or complications, while less attention is needed for the technical difficulties of laparoscopic surgery, such as counterintuitive movements.

Residents who are willing to perform laparoscopic surgery should train in laparoscopic skills on a regular basis. This is in line with previous research by Stolzenburg et al. [13], who suggest that those who are willing to learn the laparoscopic prostatectomy should practice daily on a pelvic trainer, especially knot tying and suturing. Kroeze et al. [11] stated that modular simulator training as part of a formal training programme may help to overcome some of the shortfalls in residents' exposure to laparoscopic procedures as a primary surgeon. Laguna et al. [14] stated that it is almost impossible to finalise the residency training as a qualified laparoscopic surgeon. Based on the low level of laparoscopic skills of last year's residents, it is advisable that those who are willing to perform laparoscopy as a urologist should improve their training and exposure to laparoscopy during residency or should consider a post-residency fellowship in laparoscopy.

A limitation of this study is that we could not define the parameters that predict a passing score on the E-BLUS

examination. Neither previous operative experience nor the questionnaire-administered previous training experience significantly correlated with the overall score on the examination. Possibly, the participants' self-reported experience was not an accurate indication of their actual experience; alternatively, the international and intercultural differences in residency training may have been too large to compare operative and training experience. Another limitation is that not all final-year residents attend EUREP and that only a portion of them partakes in the E-BLUS examination. Possibly, this may have caused a selection bias, resulting in a different level of laparoscopic skills among the participants of the exam compared to the general population of final-year residents.

5. Conclusions

The first results of the E-BLUS examination show that the level of basic laparoscopic skills among European residents is low. Although the quality of performance is good, most residents do not meet the validated time criteria of the E-BLUS examination. The timing and setting of the examination should be carefully evaluated to determine its future use. Moreover, regular laparoscopic training or a dedicated fellowship in laparoscopy should improve the laparoscopic level of residents in urology who intend to perform laparoscopy.

Author contributions: Willem M. Brinkman had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Brinkman, Tjiam, Schout, Koldewijn.

Acquisition of data: Brinkman, Tjiam, Van Cleynenbreugel.

Analysis and interpretation of data: Brinkman, Muijtjens.

Drafting of the manuscript: Brinkman.

Critical revision of the manuscript for important intellectual content: Tjiam, Schout, Muijtjens, Van Cleynenbreugel, Koldewijn, Witjes.

Statistical analysis: Muijtjens, Brinkman.

Obtaining funding: Witjes, Koldewijn.

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Supervision: Witjes, Schout, Koldewijn.

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Appendix A. Supplementary data

The Surgery in Motion video accompanying this article can be found in the online version at <http://dx.doi.org/10.1016/j.eururo.2013.10.036> and via www.europeanurology.com.

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