

# Recommended Basic Training Curriculum for the RobotiX Mentor

## Description

Training within a proficiency-based virtual reality curriculum may reduce errors during real surgical procedures. The following curriculum is based on Whittaker G, Aydin A, Raison N, Kum F, Challacombe B, Khan MS, Dasgupta P, Ahmed K: Validation of the RobotiX Mentor Robotic Surgery Simulator. *J Endourol.* 2016 Jan 21.

The study, by the School of Medical Education, King's College London, defined, tested and validated a robotic skills virtual reality training curriculum on the RobotiX Mentor™ using structured scientific methodology. The curriculum clearly defines a predetermined level of proficiency as well as defining the mode of training on the simulator.

Within the study, construct, face, and content validity were established for the RobotiX Mentor and feasibility and acceptability of incorporation into surgical training was ascertained. The RobotiX Mentor shows potential as a valuable tool for training and assessment of trainees in robotic skills.

The aim of the training curriculum is for an individual to acquire skills and reach a predetermined level of proficiency before progressing to more challenging cases.

The course provides a comprehensive educational package including:

### **1. Six Fundamentals of Robotic Surgery (FRS) tasks:**

- Ring Tower Transfer
- Knot Tying
- Railroad Track
- 4th Arm Cutting
- Puzzle Piece Dissection
- Vessel Energy Dissection

### **2. Four Robotic Suturing Tasks:**

- Vertical Defect Suturing
- Horizontal Defect Suturing
- Continuous Suturing
- Interrupted Suturing

## **Objectives**

### **The Fundamentals of Robotic Surgery Curriculum (FRS) Objectives:**

- Show effective navigation of the camera and use the camera clutch.
- Maneuver the instruments such that the potential of wristed instrumentation is utilized maximally for precise instrument tip positioning.
- Demonstrate the skills necessary to successfully place a suture.
- Demonstrate the skills necessary to successfully tie a square knot.
- Precisely control the needle and suture using the robot.
- Safely and effectively switch back and forth between the second and the fourth arm of the robot.
- Safely and precisely perform fine dissection without damaging the surrounding or the underlying structures. Identify and choose the correct energy pedal.
- Apply energy to precisely and safely seal and divide vessels.

### **Robotic Suturing Tasks Objectives:**

- Demonstrate basic techniques for knot tying across a vertical defect using wristed instrumentation.
- Demonstrate basic techniques for knot tying across a horizontal defect using wristed instrumentation.
- Practice techniques to complete a continuous or running suture using wristed instruments.
- Practice techniques to complete an interrupted suture using wristed instruments.
- Demonstrate basic techniques for knot tying.

### **Specialties:**

- General Surgery
- Gynecology
- Urology
- Colon and Rectal Surgery
- Otolaryngology
- Thoracic and cardiothoracic Surgery
- Gastrointestinal and Endoscopic Surgery
- Orthopedic Surgery
- Nurse practitioners and residents in Surgical Specialties

### **Target Audience:**

The psychomotor skills curriculum is designed to train and assess the proficiency of surgeons interested in performing robotic surgery.

### **Assumptions:**

It is recommended to include a cognitive skills module at the front end of the training program. No previous procedural or technical knowledge is required.

### **Suggested Time Length**

Suitable for 2 day training courses or for distributed training.

### **Authors:**

#### **The Fundamentals of Robotic Surgery Curriculum (FRS cases) was conducted by:**

Institute for Surgical Excellence. Florida Hospital Nicholson Center. Principal Investigators: R.M. Satava, University of Washington School of Medicine, Seattle, WA. R.D. Smith, Florida Hospital Nicholson Center, Celebration, FL. V.R. Patel, Florida Hospital, Global Robotics Institute, Celebration, FL.

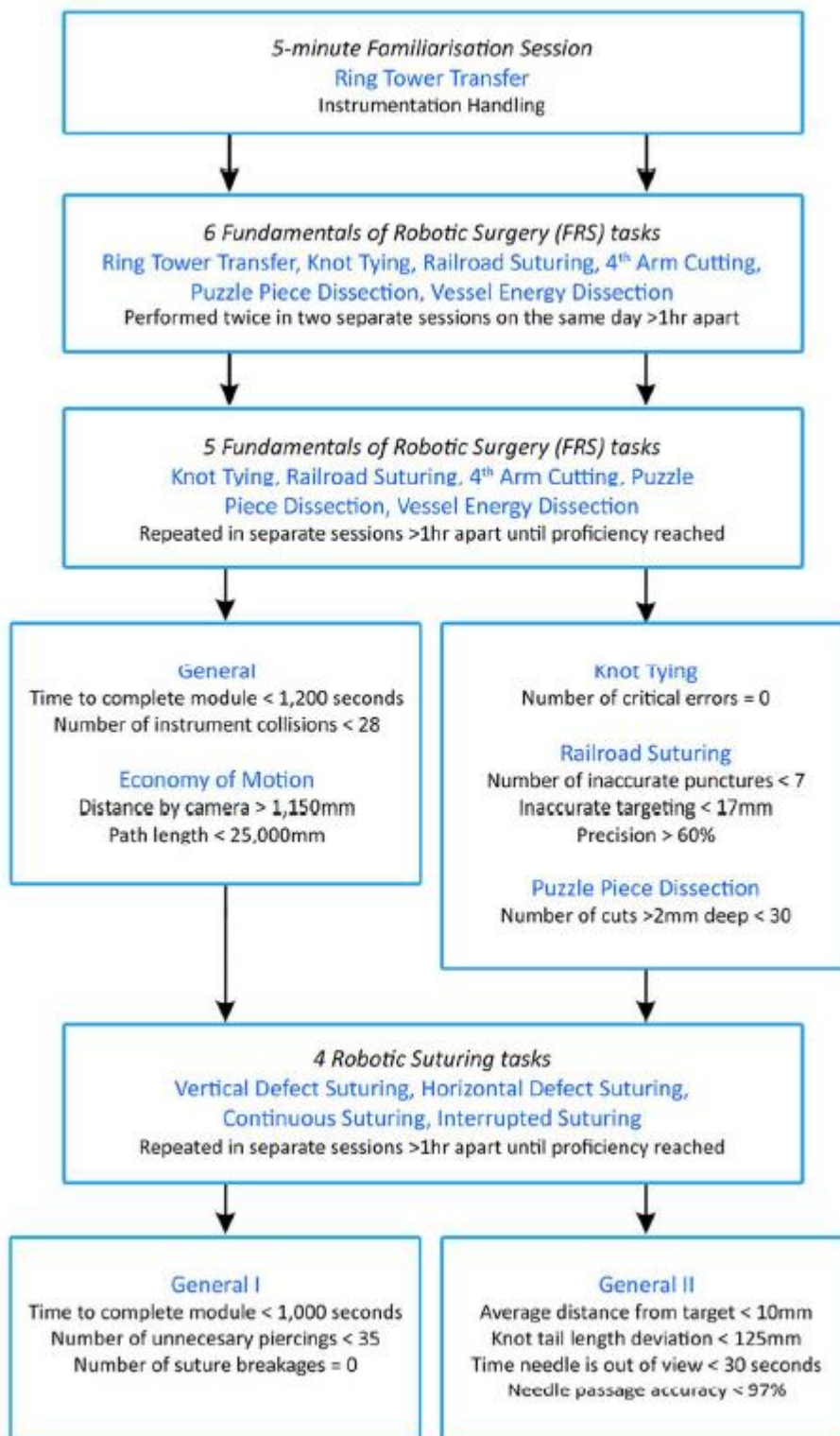
#### **The recommended basic training curriculum for the RobotiX Mentor was developed by:**

George Whittaker<sup>1</sup>, Abdullatif Aydin<sup>2</sup>, Nicholas Raison<sup>2</sup>, Francesca Kum<sup>3</sup>, Benjamin Challacombe<sup>3</sup>, Muhammed Shamim Khan<sup>2,3</sup>, Prokar Dasgupta<sup>2,3</sup>, and Kamran Ahmed<sup>2,3</sup>.

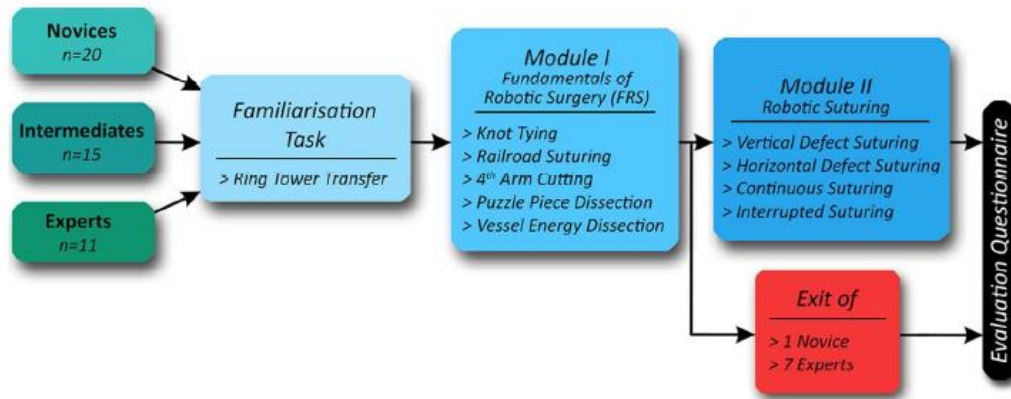
<sup>1</sup>*School of Medical Education, King's College London , London, United Kingdom .*

<sup>2</sup>*MRC Centre for Transplantation, King's College London , London, United Kingdom .*

<sup>3</sup>*Department of Urology, Guy's and St. Thomas' NHS Foundation Trust , London, United Kingdom .*



**Recommended basic training curriculum for the RobotiX Mentor. All proficiency targets are based on mean scores of the expert group.**

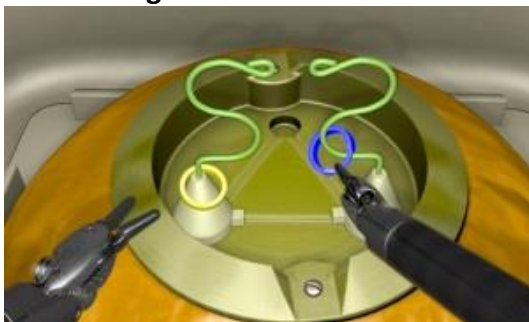


Flowchart depicting study process through which participants travel.

## Task Descriptions and Curriculum Steps

**Familiarization with the simulator:** A 5 minute session.

### **Task 1: Ring Tower Transfer**



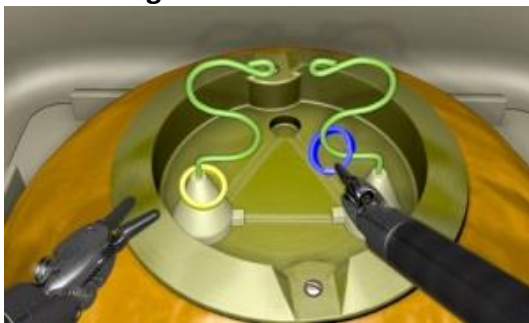
Remove a ring from the "S" tower, transfer to the other arm and place on a tower located on the side of the dome.

This task trains camera navigation, effective use of the camera clutch, and wristed instrument maneuvering for precise instrument tip positioning.

## **6 Fundamentals of Robotic Surgery (FRS) Tasks**

Performed twice, in 2 separate sessions, on the same day, > 1 hr apart.

### **Task 1: Ring Tower Transfer**



Remove a ring from the "S" tower, transfer to the other arm and place on a tower located on the side of the dome.

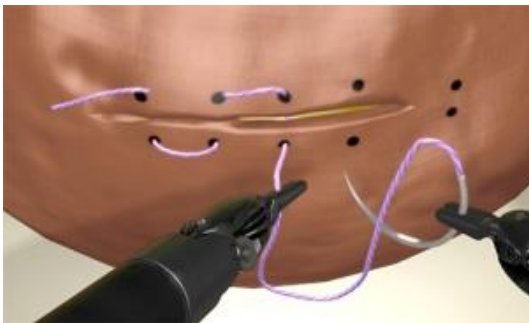
This task trains camera navigation, effective use of the camera clutch, and wristed instrument maneuvering for precise instrument tip positioning.

### Task 2: Knot Tying



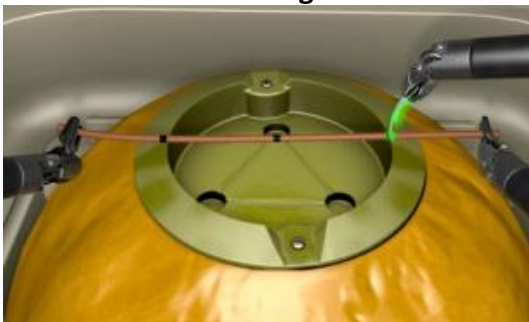
Tie a surgeon's knot to approximate the two eyelets of the "I" towers so that they touch each other. Back up the knot with a square knot (two throws). This task trains successful suture placement and square knot tying.

### Task 3: Railroad Track



Perform horizontal mattress suture through the target points to approximate the tissue. Anchor the needle by passing through the final two target points twice. This task trains precise needle control and suturing during robotic surgery.

### Task 4: 4th Arm Cutting



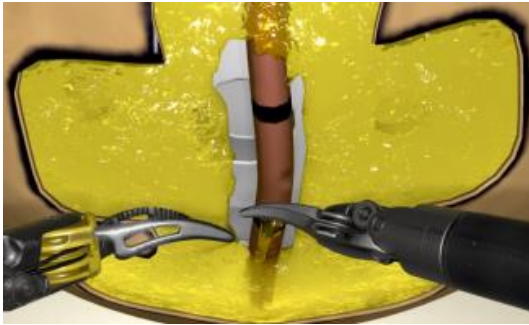
Pick up and pull the elastic band taut with 2<sup>nd</sup> and 4<sup>th</sup> arms, then use 1<sup>st</sup> arm to cut the band at the first mark on the right end of band. Repeat until band is cut at all marks and put all pieces in the cap. This task trains switching back and forth between a primary instrument and the 4<sup>th</sup> arm in a coordinated fashion.

### Task 5: Puzzle Piece Dissection



Cut out the puzzle piece shape within the designated line without incising the underlying tissue. This task trains precise fine dissection so that the skin is incised on the marked lines while not injuring or tearing the underlying tissue.

### Task 6: Vessel Energy Dissection



Dissect through the fat layer to expose the vessel, cauterize the vessel and cut the vessel. This task trains for the correct use of the pedals for electrocoagulation and accurately cutting between the sealed points.

**5 Fundamentals of Robotic Surgery (FRS) Tasks:** Repeated in separate sessions > 1 hr apart until proficiency is reached.

### Task 2: Knot Tying



#### Required skill level:

Total time (sec)	190
No. of instrument collisions	5
Distance by camera	215
Path length (L+R)	5000
Number of critical errors	0
Total number of completely detached tower	

### Task 3: Railroad Track



#### Required skill level:

Total time (sec)	315
No. of instrument collisions	6
Distance by camera	240
Path length (L+R)	5300
Number of inaccurate punctures	< 7

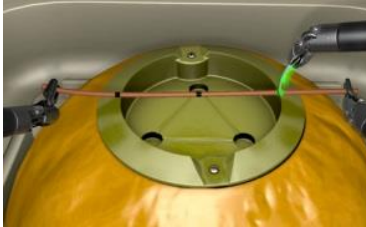
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Inaccurate targeting	< 17mm
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Precision	> 60%
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#### Task 4: 4th Arm Cutting

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Total time (sec)	90
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No. of instrument collisions	1
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Distance by camera	120
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Path length (L+R)	1250
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#### Task 5: Puzzle Piece Dissection

##### Required skill level:



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Total time (s)	480
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No. of instrument collisions	9
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Distance by camera	485
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Path length (L+R)	10500
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Number of cuts > 2mm deep	< 30
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#### Task 6: Vessel Energy Dissection



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Total time (s)	150
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No. of instrument collisions	7
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Distance by camera	110
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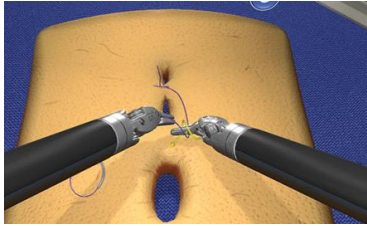
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Path length (L+R)	2700
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## 4 Robotic Suturing Tasks



### Vertical Defect Suturing

#### Objectives

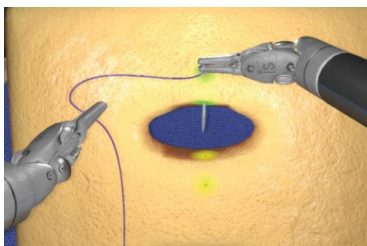
Demonstrate basic techniques for knot tying across a vertical defect using wristed instrumentation.

#### Tasks

Tie two knots at the indicated locations, follow the on-screen icons for guidance.

#### Required skill level:

Total time (s)	215
Number of unnecessary needle piercing points	7
Excessive force – suture breakage	0
Knot tail length deviation	30
Time needle is out of view (s)	4
Percentage of accurate needle passages	97%
Total number of knots	2



### Horizontal Defect Suturing

#### Objectives

Demonstrate basic techniques for knot tying across a horizontal defect using wristed instrumentation.

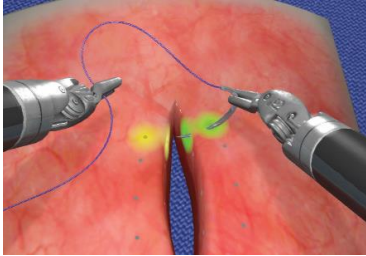
#### Tasks

Tie two knots at the indicated locations, follow the on-screen icons for guidance.

#### Required skill level:

Total time (s)	215
Number of unnecessary needle piercing points	5
Excessive force – suture breakage	0
Knot tail length deviation	25
Time needle is out of view	3

Percentage of accurate needle passages	97%
Total number of knots	2



### Continuous Suturing

#### Objectives

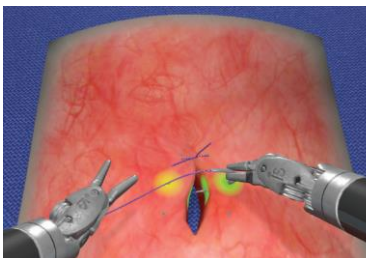
Practice techniques to complete a continuous or running suture using wristed instruments.

#### Tasks:

1. Tie a knot at the first position as an anchor for your suture.
2. Approximate the simulated tissue using a continuous, or running, suture through the indicated targets.

#### Required skill level:

Total time (s)	250
Number of unnecessary needle piercing points	12
Excessive force – suture breakage	0
Knot tail length deviation	10
Time needle is out of view (s)	15
Percentage of accurate needle passages	97%
Total number of knots	1



### Interrupted Suturing

#### Objectives:

- Practice techniques to complete an interrupted suture using wristed instruments.
- Demonstrate basic techniques for knot tying.

#### Tasks:

1. Tie a knot at each position.
2. Approximate the simulated tissue using an interrupted suture through the indicated targets.

Total time (s)	320
Number of unnecessary needle piercing points	11

Excessive force – suture breakage	0
Knot tail length deviation	60
Time needle is out of view (s)	9
Percentage of accurate needle passages	97%
Total number of knots	3