

King's College Robotic Surgical Training Curriculum

Description

Training within a proficiency-based virtual reality curriculum allows participants to track and monitor their progress in a structured and progressional manner, and provides clearly defined targets, ensuring that a universal training standard has been achieved across training surgeons.

The following curriculum is based on *Establishing objective benchmarks in robotic virtual reality simulation at the level of a competent surgeon using the RobotiX Mentor simulator* (Watkinson et al. Postgraduate Medical Journal 2018;94:270–277).

The study, by the Division of Transplantation Immunology & Mucosal Biology, Faculty of Life Sciences & Medicine, King's College London, UK, defined, tested and validated a robotic skills virtual reality training curriculum on the RobotiX Mentor™ using structured scientific methodology. The curriculum clearly defines clinically relevant benchmarks at the standard of a competent robotic surgeon that are challenging yet also attainable. That can be used within a VR training curriculum.

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. **Three Robotic Basic Skills tasks:**
 - Camera 0 manipulation
 - Wristed Manipulation Level 1
 - Wristed Manipulation Level 2
2. **Two Fundamentals of Robotic Surgery (FRS) tasks:**
 - Railroad Track
 - Knot Tying

Objectives

Robotic Basic Skills Objectives:

- To show effective navigation of the 0 degree camera and use of the clutch.
- To maintain the instruments in the field of view.
- To show effective basic eye hand coordination and instrument manipulation.
- To maneuver the instruments such that the potential of wristed instrumentation is utilized maximally for precise instrument tip positioning.

The Fundamentals of Robotic Surgery Curriculum (FRS) Objectives:

- Precisely control the needle and suture using the robot
- Demonstrate the skills necessary to successfully place a suture.
- Demonstrate the skills necessary to successfully tie a square knot.

Specialties

- Medical students
- Surgical residents
- Surgical consultants

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 familiarization cognitive skills module at the beginning end of the training program. No previous procedural or technical knowledge is required.

Authors

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

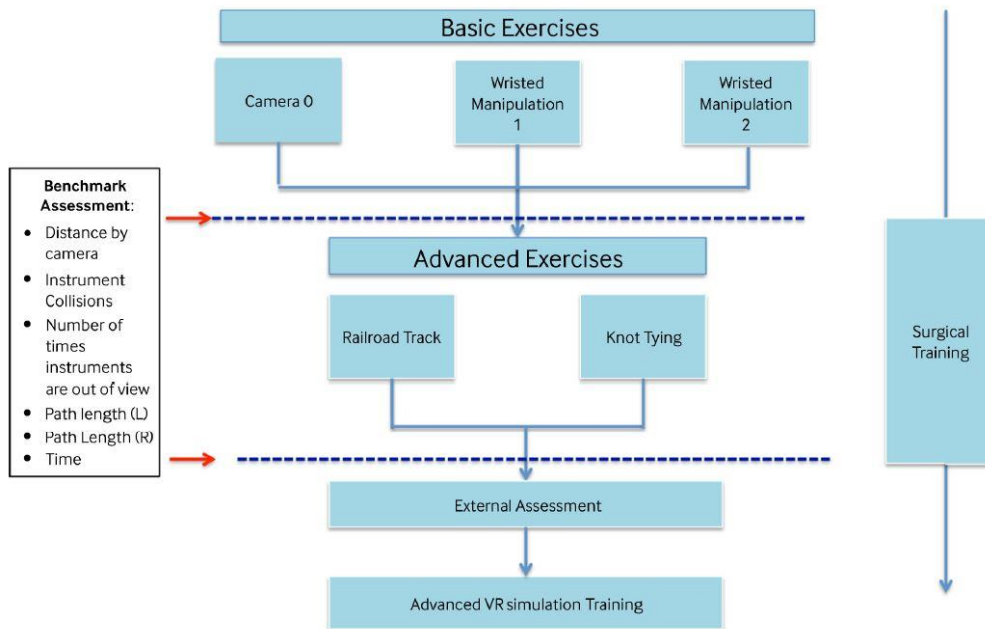
Institute for Surgical Excellence, Florida Hospital Nicholson Center. Principal Investigators: R.M. Satava, University of Washington School of Medicine, Seattle, WA. R.D. Smith, Florida Hospital Nicholson Center, Celebration, FL. V.R. Patel, Florida Hospital, Global Robotics Institute, Celebration, FL

The Robotic Basic Skills Module was developed in collaboration with:

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Proposed virtual reality training (VR) curriculum for the RobotiX Mentor


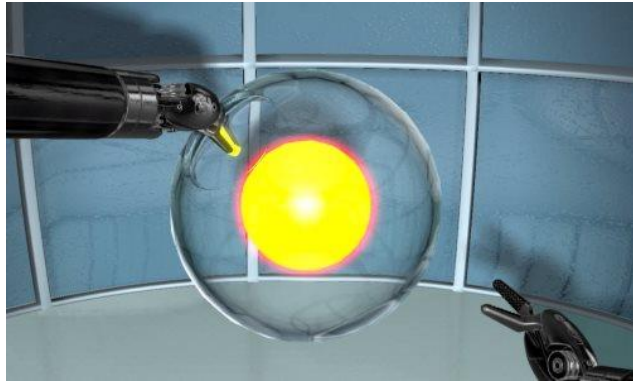
Table 2 Benchmark scores and % of novices achieving the benchmark

Exercise	Camera 0		Wristed manipulation 1		Wristed manipulation 2		Railroad track		Knot tying	
	Benchmark	Percentage of novices achieving benchmark	Benchmark	Percentage of novices achieving benchmark	Benchmark	Percentage of novices achieving benchmark	Benchmark	Percentage of novices achieving benchmark	Benchmark	Percentage of novices achieving benchmark
Distance By camera	<1358.4	48	0	97	<1087.62	14	80.8	69	0	79
Instrument Collisions	0	48	0	100	0	38	3	42	2	67
Number of times instruments are out of view	4	32	0	42	0	0	2	67	2	22
Path length (L)	1329.8	23	915.5	3	1823.9	0	1841.5	68	1714	43
Path length (R)	1381.4	26	959.3	10	1775.6	5	1676.5	54	1642.0	38
Time	125.28	16	105.1	35	120	5	218.4	35	145.8	30

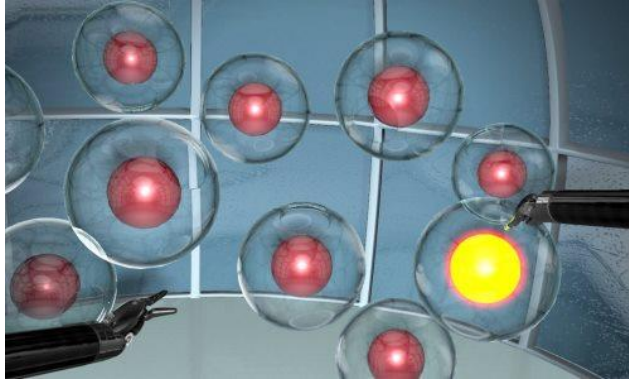
Benchmark scores and % of novices achieving the benchmark

Curriculum Steps and Task Descriptions

3 Robotic Basic Skills tasks

<p style="text-align: center;">Camera 0 manipulation</p>  <p>Required Skill Level:</p> <table border="1"> <tbody> <tr> <td>Total time (s)</td> <td>125.28</td> </tr> <tr> <td>Path length right instrument</td> <td>1381.4</td> </tr> <tr> <td>Path length left instrument</td> <td>1329.8</td> </tr> <tr> <td>Number of times instruments are out of view</td> <td>4</td> </tr> <tr> <td>Instruments collisions</td> <td>0</td> </tr> <tr> <td>Distance by camera</td> <td><1358.4</td> </tr> </tbody> </table>	Total time (s)	125.28	Path length right instrument	1381.4	Path length left instrument	1329.8	Number of times instruments are out of view	4	Instruments collisions	0	Distance by camera	<1358.4	<p>Description</p> <p>Manipulate a 0 degree camera to locate ten targets within the environment.</p> <p>To capture a target, follow the arrow and place the viewfinder on the target. Wait in place for the target to stop spinning and disappear.</p> <p>Objectives</p> <p>Show effective navigation of the 0 degree camera and use of the clutch. Maintain the instruments in the field of view.</p>
Total time (s)	125.28												
Path length right instrument	1381.4												
Path length left instrument	1329.8												
Number of times instruments are out of view	4												
Instruments collisions	0												
Distance by camera	<1358.4												
<p style="text-align: center;">Wristed Manipulation Level 1</p>  <p>Required Skill Level:</p> <table border="1"> <tbody> <tr> <td>Total time (s)</td> <td>105.1</td> </tr> <tr> <td>Path length right instrument</td> <td>959.3</td> </tr> <tr> <td>Path length left instrument</td> <td>915.5</td> </tr> <tr> <td>Number of times instruments are out of view</td> <td>0</td> </tr> <tr> <td>Instruments collisions</td> <td>0</td> </tr> <tr> <td>Distance by camera</td> <td>0</td> </tr> </tbody> </table>	Total time (s)	105.1	Path length right instrument	959.3	Path length left instrument	915.5	Number of times instruments are out of view	0	Instruments collisions	0	Distance by camera	0	<p>Description</p> <p>Use wrist articulation to precisely maneuver the highlighted tool through the glass opening and touch the glowing target. Utilize the potential of the wristed instrumentation maximally to avoid contact with the glass vessel. After reaching each target, return both hands to the initial position.</p> <p>Objectives</p> <p>Show effective basic eye hand coordination and instrument manipulation.</p> <p>Maneuver the instruments such that the potential of wristed instrumentation is utilized maximally for precise instrument tip positioning</p>
Total time (s)	105.1												
Path length right instrument	959.3												
Path length left instrument	915.5												
Number of times instruments are out of view	0												
Instruments collisions	0												
Distance by camera	0												

Wristed Manipulation Level 2



Required Skill Level:

Total time (s)	120
Path length right instrument	1775.6
Path length left instrument	1823.9
Number of times instruments are out of view	0
Instruments collisions	0
Distance by camera	<1087.62

Description

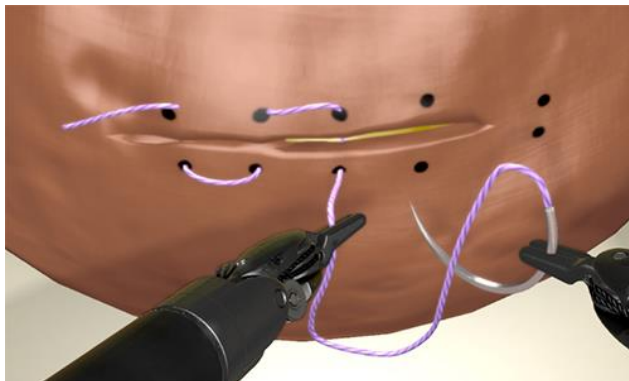
Use wrist articulation to precisely maneuver the highlighted tool through the glass opening and touch each of the ten glowing targets. Utilize the potential of the wristed instrumentation maximally to avoid contact with the glass vessels. Practice prior acquired skills such as camera and clutching as necessary.

Objectives

Show effective basic eye hand coordination and instrument manipulation. Maneuver the instruments such that the potential of wristed instrumentation is utilized maximally for precise instrument tip positioning. Show effective navigation of the camera and use of clutch.

2 Fundamentals of Robotic Surgery (FRS) tasks

Railroad Track



Required Skill Level:

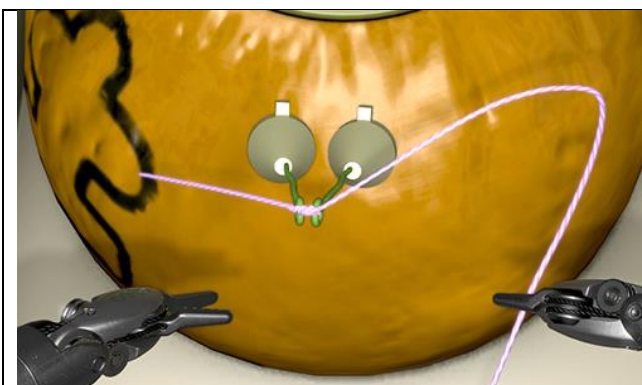
Total time (s)	218.4
Path length right instrument	1676.5
Path length left instrument	1841.5
Number of times instruments are out of view	2
Instruments collisions	3
Distance by camera	80.8

Description

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

Knot Tying

Description



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

Required Skill Level:

Total time (s)	145.8
Path length right instrument	1642
Path length left instrument	1714
Number of times instruments are out of view	2
Instruments collisions	2
Distance by camera	0