Institute for Surgical Excellence

FRS DOME PSYCHOMOTOR SKILLS CURRICULUM

Learning Objectives

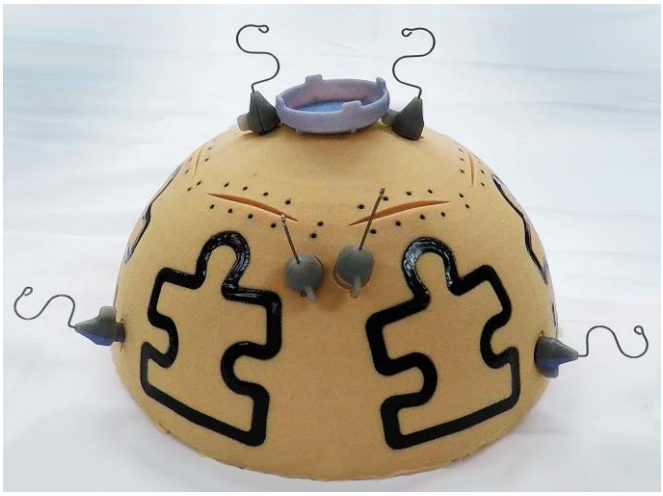
1. Familiarize oneself with the task trainer model and tasks to be performed
2. Task 1: Docking and Instrument Insertion
   - Demonstrate safe docking of the robotic arms and insertion of the instruments through the ports into the 'abdomen' box.
   - Bring the instrument tips into the operative field of view without error.
3. Task 2: Ring Tower Transfer
   - 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.
4. Task 3: Knot Tying
   - Demonstrate the skills necessary to successfully tie a square knot.
5. Task 4: Railroad Track
   - Precisely control the needle and suture using the robot.
6. Task 5: 4th Arm Cutting
   - Safely and effectively switch back and forth between the second and the fourth arm of the robot.
7. Task 6: Cloverleaf Dissection
   - Safely and precisely perform fine dissection without damaging the surrounding or the underlying structures.
8. Task 7: Vessel Energy Dissection
   - Identify and choose the unipolar and bipolar pedals correctly.
   - Apply energy to seal and divide vessels precisely and safely.

Background and General Principles

The psychomotor skills curriculum is designed to train and assess the proficiency of surgeons interested in performing robotic surgery. The curriculum will ensure that only the surgeons who are skilled and well trained in the basic skills of robotic surgery can perform such complex procedures, making the patient the ultimate benefactor.

The psychomotor skills curriculum was developed through multiple consensus conferences, which brought together subject matter experts from multiple surgical societies, surgical educational societies, surgical boards and other governing organizations who agreed upon the critical skills, tasks, and most common errors that needed to be included in a comprehensive basic curriculum. The measures that were deemed the most important by the subject matter experts were incorporated into the curriculum including the metrics for each skill/task/error and assessment tools. Twenty-five outcome measures were consolidated into the seven tasks that are described below. All the seven tasks will be completed as part of this curriculum.

Physical Model



Review how to set up the FRS Dome
https://vimeo.com/665222232
Place the dome within an abdominal model
https://vimeo.com/665230127
Proper port placement
https://vimeo.com/665231862
Review videos of FRS Dome tasks
https://www.surgicalexcellence.org/frs-dome

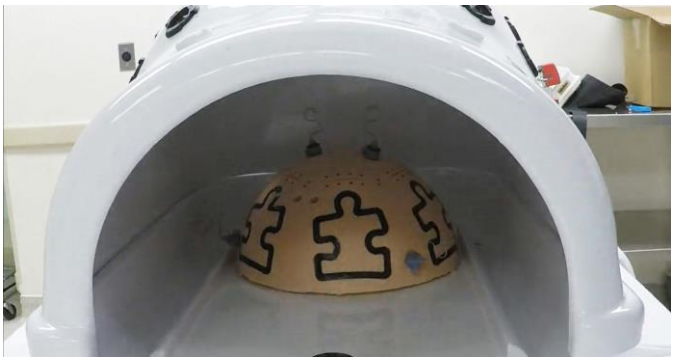
Proficiency-based Progression (PBP) Training

Proficiency-based progression (PBP) training methodology is based on unambiguously metrics defined by expert benchmarks. In PBP training, the learner engages in 'deliberate' practice and is required to demonstrate a proficiency benchmark in one task before progressing to a new, and usually, more difficult task.

Task 1: Docking and Instrument Insertion

Description

Proper docking and instrument insertion is crucial to any robotic surgery. This task trains safe docking and instrument insertion techniques to bring the instrument tips into the operative field of view without error.



Tasks

1. Dock the robotic camera arm to the camera trocar.

2. Dock other arms to instrument trocar.
3. Insert the video-scope into the camera trocar and secure the cable behind the arm.
4. Insert the long needle drivers in the two trocars of arms #1 and #2 and monopolar scissors in the trocar on the 4th arm.
5. Visualize the instruments as they emerge from the tip of the trocar
6. Confirm that all 3 instruments are in the field of view such that the entire dome and all instruments are completely visualized.

Skills Assessed

- Primary Skills Assessed:
  - Docking
  - Instrument insertion
  - Safety of operative field
- Secondary Skills Assessed:
  - Eye-hand instrument coordination

Measurements and Metrics

- Total time (minutes/seconds) until all three instruments are in view
- Accurate final position of trocars, instruments and robot arms
- Pathway (Optional)

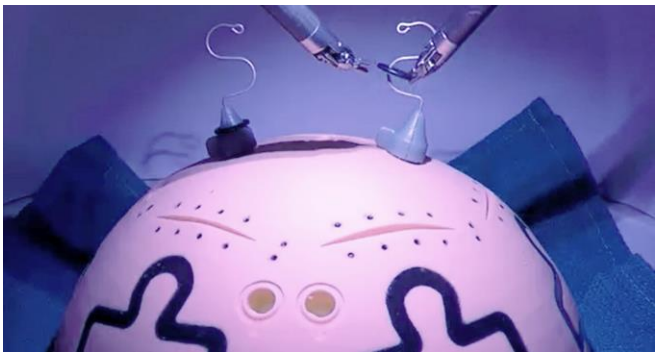
Potential Errors

- Collision of an instrument or camera with the dome
- Camera arm not in the "sweet" spot (full visual field of the dome and test objects)
- Failure to secure the camera cable behind the camera arm
- Inserting instruments/camera into the wrong ports
- Non-visualization of an instrument tip during insertion into box *(critical/fatal error)*
- Instrument tips not in view after insertion
- Instrument-instrument collision following insertion of the instruments
- Failure to press the clutch (memory) button in the end of the setup

Task 2: Ring Tower Transfer

Description

Learning to navigate the camera and the surgical instruments using a robotic system is both completely different from open surgery (and laparoscopic surgery), but also designed to be totally natural and mimicking the same motions that are used in open surgery (but opposite those motions of laparoscopic



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

Tasks

1. Pick up and remove the ring from the middle tower with one hand without touching the "S" wire.
2. Transfer the ring to opposite hand in mid-air.
3. Place the ring on the side tower without touching the "S" wire.

Skills Assessed

- Primary:
  - Eye hand instrument coordination
  - Camera navigation
  - Clutching
  - Atraumatic handling
  - Precise instrument tip positioning
- Secondary:
  - Wrist articulation
  - Ambidexterity

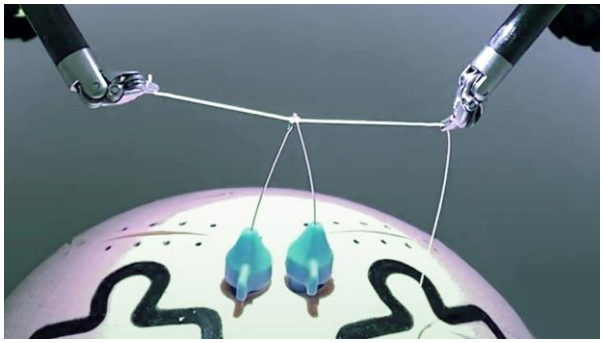
Measurements and Metrics

- Total time to transfer rings from middle to side towers (seconds)
- Total time for instrument-wire collisions (seconds).
- Instrument-instrument collisions (number of times)
- Number of ring drops

Potential Errors

- Dropping the ring
- Losing the ring *(critical/fatal error)*
- Breaking the ring *(critical/fatal error)*
- Breaking the wire *(critical/fatal error)*
- Failing to transfer hands
- Instrument-instrument collision
- Instrument-wire collision
- Popping off the wire/tower *(critical/fatal error)*

Task 3: Knot Tying



Description

Many complex surgical procedures require knot tying. In robotic surgery the surgeon

must rely on the visual cues and experience to handle the suture carefully to avoid suture breakage and tissue tearing. This task trains successful suture placement and square knot tying.

Tasks

1. Tie a surgeon's knot to approximate the two eyelets such that they touch each other.
2. Back up the knot with two more throws (total 3 knots).

Skills Assessed

- Primary:
  - Needle and suture handling
  - Knot tying
- Secondary:
  - Wrist articulation
  - Eye hand instrument coordination
  - Ambidexterity

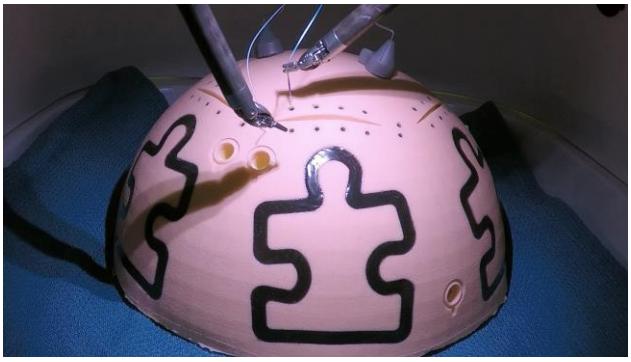
Measurements and Metrics

- Time to complete the knots (under tension)
- Approximation of the eyelets
- Security of the knot

Potential Errors

- Islets do not touch each other
- Air knot *(critical/fatal error)*
- Knot slippage or insecure knot *(critical/fatal error)*
- Suture breakage
- Instrument-instrument collision.
- Knocking off contacts with instrument *(critical/fatal error)*

Task 4: Railroad Track



Description

Precision is one of the major advantages of the robot and is particularly important in needle holding and suturing. This task trains precise needle control and suturing during robotic surgery.

Tasks

1. Perform horizontal mattress suturing through the target points to approximate the tissue

2. Tie a knot at the completion of the suturing

Skills Assessed

- Primary:
    - Needle holding and manipulation
    - Wrist articulation
    - Atraumatic tissue handling
- Secondary:
    - Eye hand instrument coordination
    - Suture handling

Measurements and Metrics

- Time to complete closure of incision and tie knot (seconds)
- Complete wound approximation
- Precision of needle placement onto dots along the incision (mm distance from center of dot)
- Amount of eversion (mm)
- Wound tension (no gap of wound edges)
- Secure knot at completion of suturing (no slipping)

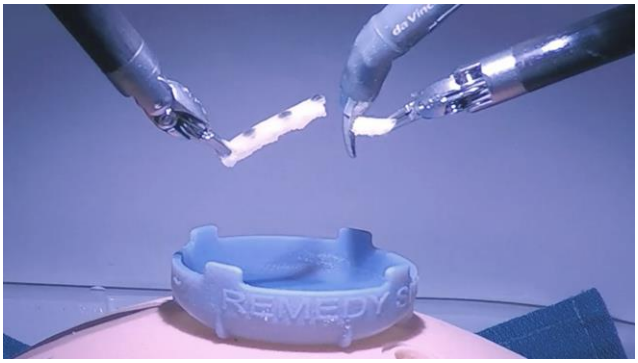
Potential Errors

- Wound separation (mm)
- Excessive eversion (mm)
- Tearing of tissue (mm of tears)
- Inaccurate targeting (mm from dots)
- Inaccurate suture technique (number of needle placements that are not in a mattress suture pattern)
- Suture breakage (number of times)
- Needle breakage *(critical/fatal error)*

Task 5: Fourth Arm Cutting

Description

In robotic surgery, the presence of the fourth arm allows the surgeon to have direct control of both the camera and an additional arm. However, controlling four arms (with only two hands) poses some challenges. This requires hand and foot coordination to activate one instrument while inactivating another with possible



concurrent camera repositioning. This task trains the switching back and forth between a primary instrument and the 4th arm in a coordinated fashion.

Tasks

1. Pick up the vein with one hand and use the other hand to provide retraction.
2. Switch to the 4th arm and use the monopolar scissors to cut the vein transversely at the hash mark.
3. Switch back to the retracting instrument and readjust to provide adequate retraction.
4. Repeat switching to 4th arm, cutting and retraction till the entire vein' is cut at all the hash marks.

Skills Assessed

- Primary:
  - Multiple arm control
  - Cutting
- Secondary:
  - Atraumatic handling
  - Eye hand coordination

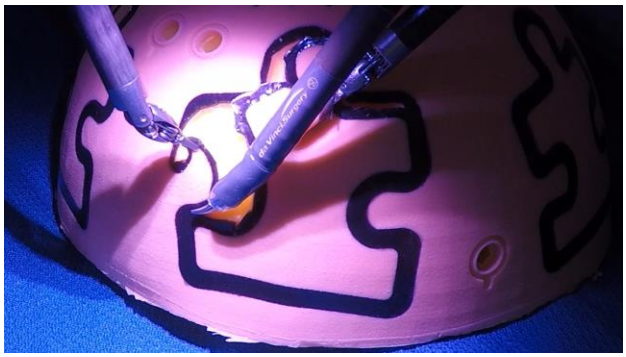
Measurements and Metrics

- Time to cut all three hash marks (seconds)
- Accuracy of cutting on hash marks (mm distance from center of hash mark)
- Retraction (adequate exposure of vein)
- Stretching of the vein (adequate tension on vein)

Potential Errors

- Inadequate tension of the vein (vein sags loosely)
- Tearing of vein
- Failure to switch arm
- Cut is not completely on the hash mark
- Dropping the vein
- Instrument – instrument collision

Task 6: Cloverleaf Dissection



Description

Fine dissection and tissue plane separation are important surgical skills. However, injury to surrounding structures or tissue tearing can have serious clinical implications. This task

trains for precise fine dissection such that the skin is incised on the marked lines while not injuring or tearing the underlying tissue.

Tasks

1. Cut the cloverleaf pattern between the lines without incising the underlying tissue or cutting outside of the lines.

Skills Assessed

- Primary:
  - Dissection
  - Cutting
  - Atraumatic tissue handling
  - Sharp and blunt dissection
- Secondary:
  - Eye hand coordination
  - Wrist articulation

Measurements and Metrics

- Time to completely dissect the cloverleaf (sec)
- Accuracy of remaining within the lines (mm)
- Tissue handling

Potential Errors

- Tearing of tissue
- Cutting outside the lines
- Incision of underlying tissue
- Instrument-instrument collision

Task 7: Vessel Energy Dissection

Description

In robotic electrocoagulation, activation is accomplished by the use of the foot pedals. Thus, in robotic surgery if the incorrect pedal is pressed during electrocoagulation of a vessel, serious hemorrhage could occur. It is important to use the correct pedals. This task trains for the correct use of the pedals for electrocoagulation and accurately cutting between the sealed points.

Tasks

1. Incision and retraction of the flap upwards with the 4th arm
2. Dissection through the fat to expose the pulsating vessel
3. Seal the vessel using Maryland bipolar at the solid hash marks
4. Cut the vessel at the dotted hash mark

Skills Assessed

- Primary:
    - Accurate activation and use of energy sources (electrocoagulation)
    - Dissection of vessels and tissues
    - Cutting and coagulation of vessels
    - Multiple arm control
- Secondary:
    - Atraumatic handling
    - Eye hand instrument coordination

Measurements and Metrics

- Time to complete dissection, vessel sealing and vessel cutting (sec)
- Accuracy (mm)
- Quality of vessel seal (leaking)
- Blood loss (cc)

Potential Errors

- Injury to vessel (vessel leaks fluid)
- Tearing the flap
- Instrument-instrument collision
- Cutting/Energy applied outside the marks (or vessel leaking)

Global Scoring Guidelines (GEARS)

Depth perception

1	2	3	4	5
Constantly overshoots target, wide swings, slow to correct		Some overshooting or missing of target, but quick to correct		Accurately directs instruments in the correct plane to target

Bimanual dexterity

1	2	3	4	5
Uses only one hand, ignores nondominant hand, poor coordination		Uses both hands, but does not optimize interaction between hands		Expertly uses both hands in a complementary way to provide best exposure

Efficiency

1	2	3	4	5
Inefficient efforts; many uncertain movements; constantly changing focus or persisting without progress		Slow, but planned movements are reasonably organized		Confident, efficient and safe conduct, maintains focus on task, fluid progression

Force sensitivity

1	2	3	4	5
Rough moves, tears tissue, injures nearby structures, poor control, frequent suture breakage		Handles tissues reasonably well, minor trauma to adjacent tissue, rare suture breakage		Applies appropriate tension, negligible injury to adjacent structures, no suture breakage

Robotic control

1	2	3	4	5
Consistently does not optimize view, hand position, or repeated collisions even with guidance		View is sometimes not optimal. Occasionally needs to relocate arms. Occasional collisions and obstruction of assistant.		Controls camera and hand position optimally and independently. Minimal collisions or obstruction of assistant