



# FUNDAMENTALS OF LAPAROSCOPIC SURGERY

## Technical Skills Proficiency-Based Training Curriculum

The FLS program may be effectively used to teach and assess both cognitive and technical skill aspects related to laparoscopic surgery. Over the past two years, SAGES FLS committee members have developed a technical skills curriculum specifically designed for use in residency training programs. The curriculum is proficiency-based, whereby trainees are oriented to the materials and self-practice until expert-derived performance levels are reached.

Residents may practice as much or as little as needed in order to acquire the validated skills incorporated into the FLS modules. The video materials serve as a robust source of feedback for the learner and additional proctoring is considered optional. This protocol ensures that all trainees achieve an excellent level of performance, and has correlated with a uniform successful passing score according to the FLS technical skills testing criteria. We recommend this curriculum for all resident levels. Surgery interns may benefit by mastering these skills early in their training, such that they are better prepared for opportunities in the operating room and can undergo additional training throughout their residency as needed. Similarly, mid-level and senior residents may benefit by ensuring that all trainees have suitable skills to perform a wide array of laparoscopic procedures.

We have partnered with other ongoing national initiatives, and this curriculum is now part of the Basic and Advanced Laparoscopic Skills Modules included in the ACS/APDS National Skills Curriculum Project; detailed information concerning these modules is available through the ACS website ( [www.facs.org/education/surgicalsills/html](http://www.facs.org/education/surgicalsills/html) ).

### I. OVERVIEW OF TRAINING AND TESTING

The original MISTELS tasks were modified from their original testing format to facilitate a simplified training format that is easier to score and amenable to real-time assessment for proficiency-based training. Thus, two formats for administering the FLS drills and assessment now exist. The original format is for high-stakes assessment used as part of the FLS certification process and is primarily designed for testing purposes. The newly developed Training Curriculum outlined in this protocol is designed for proficiency-based training for individuals who need to acquire laparoscopic skills.

For the Training Curriculum, two score sheets are used: 1) the original FLS Skills Testing Score Sheet is used for pre and post-testing and 2) the more recently developed FLS Skills Training Score Sheet is used for training, with modifications of the scoring system that allow on-the-fly scoring with immediate feedback to the learner. The materials for both the FLS Testing and Training formats are identical, except for Task 2 (Precision Cutting), which was modified for training; the Training Gauze has 2 concentric marked circles whereas the Testing Gauze has a single circular mark. This modification was necessary because the scoring system for the testing gauze is somewhat cumbersome and does not lend itself to real time scoring. The double circle training gauze should ONLY be used in training and the single circle gauze is the ONLY gauze

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Approved by the SAGES FLS Committee 4/25/06



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allowed for testing. When the double circle gauze is used, ALL cuts must be made within the white space between the two circles. Any cut that deviates into either circle would represent a violation of the error parameter of the proficiency-based curriculum. An introduction to the curriculum should be performed prior to training using the video tutorials found on FLS online didactics, Module #5 and the box-trainer materials. Proctored testing can be done before and after training and is recommended so that improvement can be tracked; if Post-testing is performed according to the high-stakes examination guidelines at a designated FLS Test Center, the test results may be used for certification purposes. Training can be done with or without proctoring (some periodic proctoring may be helpful but is not necessary), as trainees are encouraged to rely heavily upon the video tutorials in a self-study fashion, thus minimizing the need for personnel resources.

During training, the Training Score Sheets and Materials should be used, as described below, within the context of the proficiency-based curriculum (reaching proficiency levels according to the specified protocol). The proficiency levels were derived from the mean performance of two experts who performed five repetitions of each task; the data were suitably homogeneous as there were no outliers ( $> 2$  s.d. beyond the mean) and no trimming was required. These expert-derived performance levels have been tested in a multi-institutional fashion and have been determined to be suitable endpoints for training, as they were uniformly achievable with practice for novices without prior operative exposure. Moreover, following this proficiency-based curriculum, all trainees successfully passed the skills portion of the FLS high-stakes examination. Note the data reported regarding time allocation and resources needed are for complete novices; less time and fewer resources may be required for more advanced learners or individuals with prior simulator experience. The goal of this curriculum is to teach trainees FLS laparoscopic skills in an effective and efficient format, with 100% pass rate on the FLS skills test. The cognitive portion of the FLS program can be taught using the FLS online didactics, Modules #1-4 and is not covered in the scope of this skills curriculum although FLS certification requires mastery of the cognitive material as well.

## II. INTRODUCTION AND PRE-TEST (RECOMMENDED)

Objective: familiarize all trainees with trainer box, supplies, setup, instrumentation, tasks performance guidelines, start and stop times, self-scoring methods, and online video tutorials; document baseline performance.

### Introduction and Pre-test (1 hour per trainee, 1:1 to 1:3 proctoring)

Pre-testing is recommended in order to track improvement but is optional.

1. Each trainee watches the videos on FLS online Module# 5 for all 5 tasks.
2. Each trainee again watches each task on FLS online Module #5 immediately prior to testing.



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3. Each trainee performs one repetition of each task immediately following the 2<sup>nd</sup> viewing of the video with each repetition scored on the FLS Testing Score Sheet.
4. Repeat steps #2 and 3, above, until each trainee has performed one repetition of all five tasks, in order (Task 1, then Task 2, then Task 3, etc.)

Time requirements: 15 minutes for step #1, 45 minutes for step #2-4, 1 hour total.

Personnel Requirements: 1 hour per trainee; up to 1:3 proctoring may be used depending on the experience of the proctoring team.

Materials: FLS online didactics, Module #5, training box exercises with Testing Supplies (including Testing Gauze for Task 2), FLS Testing Score Sheets.

Timing: The Introduction and Pretest should be conducted prior to training.

### III. TRAINING

Objective: for all trainees to practice a sufficient amount to demonstrate proficiency for all tasks.

#### Training Protocol and Proficiency Levels

Training should be performed in a self-study fashion with a heavy reliance on the video tutorials. Additional feedback may be given on an as-needed basis, especially if a trainee is having difficulty achieving the proficiency levels for any task. Performance should be monitored by regularly reviewing the progress of each trainee. Each trainee should practice each of the five tasks in order (Task 1 until proficiency is achieved, then Task 2, then Task 3, etc.). The score of each repetition should be recorded on the Training Score Sheets and Training Supplies (including Training Gauze for Task 2) should be used.

Proficiency-based training should be conducted using the performance levels and the protocol listed below. For Task 1, the task should be practiced until it can be performed in 48 seconds with no pegs dropped outside of the field of view; this level of performance should be achieved on 2 consecutive repetitions and then again on 10 more nonconsecutive repetitions for reinforcement. If a trainee cannot achieve this level of performance in 80 repetitions, that trainee should proceed to Task 2. For Task 2, the task should be practiced until it can be performed in 98 seconds with all cuts made within the section between the two lines of the Training Gauze; this level of performance should be achieved on 2 consecutive repetitions or for a maximum of 80 repetitions. For Task 3, the task should be practiced until it can be performed in 53 seconds with up to 1mm accuracy errors; this level of performance should be achieved on 2 consecutive repetitions or for a maximum of 80 repetitions. For Task 4, the task should be practiced until it can be performed in 136 seconds with up to 1mm accuracy errors; this level of performance should be achieved on 2 consecutive repetitions or for a maximum of 80 repetitions. For Task 5, the task should be practiced until it can be performed in 112 seconds with up to 1mm accuracy



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errors; this level of performance should be achieved on 2 consecutive repetitions and then again on 10 more nonconsecutive repetitions for reinforcement or for a maximum of 80 repetitions.

The proficiency levels and the training protocol are summarized in the table below.

Task	Task Name	Proficiency Level*	Seconds	Allowable Errors	Repetitions**
1	Peg Transfer	mean	48	no drops outside field of view	2 consecutive + 10 nonconsecutive
2	Precision Cutting	mean + 2 s.d.	98	all cuts between 2 circles of the training gauze	2 consecutive
3	Ligating Loop	mean + 2 s.d.	53	up to 1mm accuracy error allowed	2 consecutive
4	Suture with Extracorporeal Knot	mean + 2 s.d.	136	up to 1mm accuracy error allowed	2 consecutive
5	Suture with Intracorporeal Knot	mean + 2 s.d.	112	up to 1mm accuracy error allowed	2 consecutive + 10 nonconsecutive

\*Based on expert-derived performance

\*\*Maximum number of repetitions required is 80

### Training Scheduling

For optimal benefit, training should be conducted in a distributed fashion with a maximum duration of 1 to 1.5 hours per session with at least several hours before repeated practice. A maximum of 2 sessions per day may be conducted but additional training should be avoided to minimize fatigue. Ideally, 1 hour training sessions may be held up to several times per week and conducted for as long as necessary to complete the curriculum.

### Training Duration

Training duration is determined by the speed of skill acquisition of each trainee. Since this is a proficiency-based curriculum, the duration of training will vary as individuals will have variable levels of prior experience and will achieve proficiency at different rates. For complete novices, skill acquisition requires on average 10 hours of practice with a range of 6-14 hours. For more advanced trainees, less time may be needed. A sign-in log may be helpful to track training duration.

### Number of Repetitions and Materials

Similar to training duration, the number of repetitions to reach proficiency will vary according to individual rates of skill acquisition. Listed below are the mean number of repetitions required to demonstrate proficiency according to the protocol described above along with the range in parentheses; these data are for complete novices and fewer repetitions may be required for more advanced trainees. These data may assist the instructor in allotting sufficient consumable materials including Training Gauze for Task 2, Endoloops for Task 3, and suture for Tasks 4 & 5. With regard to reusable materials, Task 1 requires the Peg Transfer model which can be used repetitively without replacement, Task 2 only requires replacement of the Training Gauze, Task 3 requires replacement of the foam model after approximately 50 repetitions, and Task 4 & 5



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require replacement of the penrose drain model after approximately 10-15 repetitions. Sufficient laparoscopic instruments should be on hand as well so that malfunctioning equipment may be easily replaced.

Task 1	Task 2	Task 3	Task 4	Task 5	Total
57 (26-80)	18 (4-31)	8 (2-36)	7 (3-14)	28 (15-52)	119 (66-161)

### IV. POST-TEST (RECOMMENDED)

Objective: document final performance.

Post-test (30 minutes per trainee, 1:1 to 1:3 proctoring)

Post-testing is recommended in order to track improvement but is optional. Post-testing may be performed as part of the high-stakes FLS examination. When combined with the high-stakes FLS cognitive testing, skills Post-testing can serve as part of the certification process.

1. Each trainee performs one repetition of each task with each repetition scored on the FLS Testing Score Sheet.
2. Repeat testing for all 5 tasks.

Time requirements: 30 minutes per trainee.

Personnel Requirements: 30 minutes per trainee; Up to 1:3 proctoring may be used depending on the experience of the proctoring team, but 1:1 proctoring is required if post-testing is being performed as part of the high-stakes certification examination.

Materials: FLS training box exercises with Testing Supplies (including Testing Gauze for Task 2), FLS Testing Score Sheets.

Timing: The Post-test should be conducted after documented completion of the training curriculum.