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CAN MEDICAL STUDENTS ACHIEVE SKILLS PROFICIENCY THROUGH SIMULATION TRAINING?

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ABSTRACT

Background: Learning clinically relevant technical skills is a major objective of the surgery clerkship. The purpose of this study was to evaluate the feasibility and benefit of a proficiency-based skills curriculum during the eight-week third year clerkship.

Methods: During one academic year, students (n=204) were enrolled in an IRB-approved study. Students completed pre- and post-participation questionnaires. The curriculum included bladder catheterization, breast examination, and knot-tying (1 & 2 handed). The catheterization and breast components using models were taught as single proctored group sessions with a final global rating of proficiency. The knot-tying curriculum was based on previously validated bench models (time and error scoring) and included orientation, pre-testing, self-practice, and post-testing; trainees were encouraged to practice until they could comfortably achieve student-level proficiency scores. Additional feedback was given through video tutorials and proctor-led practice sessions. Comparisons were by signed rank and chi-square tests; values are mean ± s.d.

Results: For catheterization and breast examination, 100% of trainees (n=204) demonstrated proficiency. Self-rated comfort increased from 10% to 98% ($p<0.001$) for catheterization and from 38% to 90% ($p<0.001$) for breast examination; 86% of trainees indicated that the models were helpful and 92-95% indicated that the proficiency levels were appropriate. For knot-tying, 83% of trainees (n=169) completed the curriculum; objective performance scores improved from 62.9 ± 28.3 to 94.4 ± 20.0 ($p<0.001$) for 2-handed and from 49.2 ± 35.1 to 89.6 ± 22.1 ($p<0.001$) for 1-handed tasks. Achievement of proficiency improved from 5% to 57% ($p<0.001$) for 2-handed and from 4% to 44% ($p<0.001$) for 1-handed tasks. Self-rated comfort increased from 28% to 91% ($p<0.001$) for 2-handed and from 19% to 79% ($p<0.001$) for 1-handed knot-tying; 90% felt more comfortable with their knot-tying skills, 84% indicated that the models were helpful, and 93% indicated that the proficiency levels were appropriate.

Conclusions: Uniform achievement of proficiency is feasible for proctored group sessions (catheterization and breast examination). Self-training to achieve optimal acquisition of knot-tying skills may be more difficult to enforce. Nonetheless, objective scores and trainee self-ratings suggest that this curriculum improves performance and is beneficial.

BACKGROUND

- Teaching basic skills is an important component of third year surgery clerkships
- Skills training is being shifted from the clinical arena to the simulation laboratory[1,2]
- There is no standard curriculum for teaching the basic skills

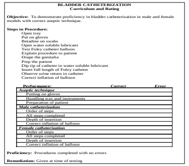
AIMS

- Demonstrate that medical students can achieve basic skills proficiency through simulation training
- Evaluate the feasibility and benefit of this curriculum

MATERIALS AND METHODS

- Medical students (n=204) in the eight week surgery clerkship in 2006 – 2007
- Survey before and after training to determine comfort level, prior experience, self-rating of performance, and self-practice time
- Bladder catheterization and breast examination
  - Latex models used (Life/Form Replicas at $478 each for catheterization and Limbs and Things Strap-on breasts and diagnostic breast trainer at $1365 and $706 respectively)
  - Proctored group session on day 2 of clerkship
  - Proficiency defined as correct performance of all steps without error
  - Remediation given at the time of testing if needed
- Open skills: one-handed and two-handed knot tying
  - Previously validated tasks[3,4]
  - Video instruction on day 2 of clerkship and reviewed at any time
  - 2-0 silk ties using knot tying boards (Covidien and Ethicon)
  - Proficiency based on time and errors:

    Score = Cutoff Time (120 seconds) – Completion Time – 10(Sum of the Errors)
  - Proficiency training goals were defined as student-appropriate levels[5]
- Declared proficient if score 100 or greater (task completion in 20 seconds with no errors)
  - Self-practice strongly encouraged
  - Pre-test (day 2) and post-test (day 47) given
- Statistical analysis using frequency counts and comparison by signed rank and Chi-square tests



BLADDER CATHETERIZATION
Curriculum and Rating

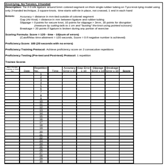
Objective: To demonstrate proficiency in bladder catheterization in male and female models with correct aseptic technique.

Steps in Procedure:
Open tray
Put on gloves
Betadine on swabs
Open water soluble lubricant
Test Foley catheter balloon
Explain procedure to patient
Drape the genitalia
Prep the patient
Dip tip of catheter in water soluble lubricant
Insert full length of Foley catheter
Observe urine return in catheter
Correct inflation of balloon

Performance:	*Correct*	*Error*
Aseptic technique		
Putting on gloves		
Handling tray and instruments		
Preparation of patient		
Male catheterization		
Order of steps		
All steps completed		
Depth of insertion		
Correct inflation of balloon		
Female catheterization		
Order of steps		
All steps completed		
Depth of insertion		
Correct inflation of balloon		

Proficiency: Procedures completed with no errors

Remediation: Given at time of testing



Knot-tying, No Tension, 2-handed
Description: Tie 2-0 silk ligature around 5mm colored segment on thick single rubber tubing on Tyco knot-tying model using only 2-handed technique, *3 square knots*, time starts with tie in place, not crossed, 1 end in each hand

Errors:
Accuracy = distance in mm tied outside of colored segment
Gap (Air Knot) = distance in mm between ligature and rubber tubing
Slippage = 0 points for secure knot, 10 points for slippage > 3mm, 20 points for disruption
(measure by cutting tails to 1 cm and "butting" the knot using pointed scissors)
Breakage = 20 points if ligature is broken during any portion of exercise

Scoring Formula: Score = 120 - time - 10(sum of errors)
(Cutoff/Max time allotment = 120 seconds, Score = 0 if negative number is achieved)

Proficiency Score: 100 (20 seconds with no errors)

Proficiency Training Protocol: Achieve proficiency score on 2 consecutive repetitions

Proficiency Testing (Pre-test and Post-test) Protocol: 1 repetition

Trainee Scores

[illegible]	Date	Repetition No.	Time	Accuracy Error x 10	Gap Error x 10	Slippage Error x 10	Breakage Error x 10	Score
		1						
		2						
		3						
		4						
		5						
		6						
		7						
		8						
		9						
		10						
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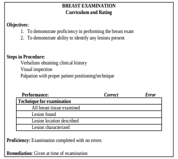


BREAST EXAMINATION
Curriculum and Rating

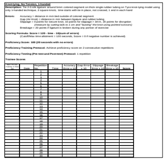
Objectives:
1. To demonstrate proficiency in performing the breast exam
2. To demonstrate ability to identify any lesions present

Steps in Procedure:
Verbalizes obtaining clinical history
Visual inspection
Palpation with proper patient positioning/technique

Performance:	*Correct*	*Error*
Technique for examination		
All breast tissue examined		
Lesion found		
Lesion location described		
Lesion characterized		

Proficiency: Examination completed with no errors

Remediation: Given at time of examination



Knot-tying, No Tension, 1-handed
Description: Tie 2-0 silk ligature around 5mm colored segment on thick single rubber tubing on Tyco knot-tying model using only 1-handed technique, *3 square knots*, time starts with tie in place, not crossed, 1 end in each hand

Errors:
Accuracy = distance in mm tied outside of colored segment
Gap (Air Knot) = distance in mm between ligature and rubber tubing
Slippage = 0 points for secure knot, 10 points for slippage > 3mm, 20 points for disruption
(measure by cutting tails to 1 cm and "butting" the knot using pointed scissors)
Breakage = 20 points if ligature is broken during any portion of exercise

Scoring Formula: Score = 120 - time - 10(sum of errors)
(Cutoff/Max time allotment = 120 seconds, Score = 0 if negative number is achieved)

Proficiency Score: 100 (20 seconds with no errors)

Proficiency Training Protocol: Achieve proficiency score on 2 consecutive repetitions

Proficiency Testing (Pre-test and Post-test) Protocol: 1 repetition

Trainee Scores

[illegible]	Date	Repetition No.	Time	Accuracy Error x 10	Gap Error x 10	Slippage Error x 10	Breakage Error x 10	Score
		1						
		2						
		3						
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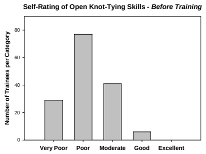
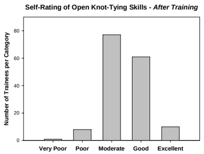
RESULTS

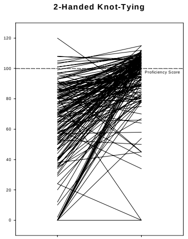
- For bladder catheterization and breast examination, 100% of trainees (n=204) demonstrated proficiency
- Self-rated comfort increased from 10% to 98% ($p<.001$) for bladder catheterization and from 38% to 90% ($p<.001$) for breast examination
- For knot-tying, 19 trainees (83%) completed the curriculum
- Self-rated comfort increased from 28.1% to 91% ($p<.001$) for two-handed knot tying and from 18.9% to 79.5% ($p<.001$) for one-handed knot tying
- For two-handed knot tying 4.7% were proficient before training and 57.4% after training ($p<.001$)
- For one-handed knot tying 3.5% were proficient before training and 44.4% after training ($p<.001$)



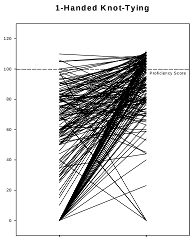
Self-Rating of Open Knot-Tying Skills - *Before Training*



Self-Rating of Open Knot-Tying Skills - *After Training*



2-Handed Knot-Tying



1-Handed Knot-Tying

DISCUSSION

- Simulation provides a learner-centered, safe environment for acquisition of skills
- Proficiency-based evaluation of performance is effective and recognizes varying rates at which learners acquire skills
- Emphasis on self-practice for open skills reduced scheduling limitations and limited faculty involvement
- This curriculum may be applicable to clerkships of shorter duration
- Increased mentoring or mandating completion may result in 100% of trainees completing the open skills curriculum (only 83% in this study)
- Additional repetitions (only one attempt was allowed during testing) may provide a more accurate measure of performance

CONCLUSIONS

- Uniform achievement of proficiency is feasible for proctored group sessions (catheterization and breast examination)
- Additional training time and mentoring may allow more uniform completion of the knot-tying curriculum component
- Objective scores and trainee self-ratings suggest that this curriculum improves performance and is beneficial

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ACKNOWLEDGEMENTS

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