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All for knots: evaluating the effectiveness of a proficiency-driven, simulation-based knot tying and suturing curriculum for medical students during their third-year surgery clerkship

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Abstract

BACKGROUND: We evaluated the effectiveness of implementing a proficiency-driven, simulation-based knot tying and suturing curriculum for medical students during their 3rd-year surgery clerkship.

METHODS: Medical students on the 3rd-year surgical clerkship completed a proficiency-driven, simulation-based knot tying and suturing curriculum consisting of 6 tasks. The effectiveness was evaluated by comparing the initial presession scores to the final postsession scores on an 8-item self-efficacy scale and evaluating pass rates on end of clerkship skills testing. A paired *t* test was used to analyze data.

RESULTS: Sixty-five students had matched preintervention and postintervention questionnaires for analysis. Pass rates approached 100% by the 3rd attempt on all tasks. Significant gains on all 8 items of the self-efficacy questionnaire from pretraining to post-training were noted. Timing of the general surgery rotation did not impact results.

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CONCLUSIONS: Implementation of a simulation-based training, proficiency-driven knot tying and suturing curriculum for 3rd-year medical students during the surgery clerkship is feasible and effective in improving student self-efficacy and objective proficiency toward performance of the tasks taught.

Suturing and knot tying are fundamental technical skills used in a variety of medical specialties (ie, surgery, obstetrics or gynecology, emergency medicine, interventional radiology). Consequently, one of the first things taught during 3rd-year medical student surgery clerkships is how to suture and tie knots. Given their importance in the specialty, many attending surgeons assume that these skills are learned by all students by the end of the clerkship. Unfortunately, such learning does not always occur, and students do not acquire these essential skills. A recent survey of 4th-year medical students demonstrated a statistically significant negative gap between students' perceived and desired competence related to suturing.[1] The result is that many medical students are not able to suture competently after completing a 3rd-year surgery clerkship.

In an attempt to correct this learning gap, surgical educators have worked hard at honing teaching strategies to ensure better adoption of basic suturing and knot tying. For example, research has demonstrated that guidance in looping techniques and knot placement are key features to emphasize when teaching novices how to suture.[2] Additionally, a student:instructor ratio of 4:1 is the most ideal for teaching.[3] More recent work has demonstrated that verbal feedback,[4] computer-based teaching,[5] and self-directed learning[6] are effective methods used for teaching students to suture and tie. In fact, successfully teaching suture and knot tying to students has been shown to increase their interest in surgical specialties.[7]

Simulation-based training (SBT) is a safe, efficient manner for teaching technical skills to novices and experts alike. Established educational principles shown to enhance technical skill acquisition include training to a predetermined expert and/or proficiency standard,[8] distributed training of skills, deliberate practice of skills,[9] the use of mental rehearsal,[10] and periodic retesting to ensure retention.[11] Incorporating some or all of these principles into an SBT suturing and knot-tying curriculum for medical students rotating on their 3rd-year surgery clerkship is an attractive option for ensuring that every student completing the clerkship has attained a minimal level of competency related to these fundamental surgical skills. In addition, creating such a curriculum would assist in providing demonstrable evidence of students reaching a minimal competency level related to surgical skills for accreditation bodies.

A potential barrier for such a curriculum is the cost of purchasing the necessary suture and ligature for students to complete it. Even using discounted rates for second-hand suture sold on the Internet, the cost of supplying almost 200 students can quickly reach 4 figures per annum. Fortunately, less-expensive alternatives to medical grade suture and needles exist, providing a more realistic cost structure.

We endeavored to evaluate the effectiveness of implementing a proficiency-driven, simulation-based, knot-tying and suturing curriculum for all medical students rotating through their 3rd-year surgery clerkship using low-cost alternatives to suture and ligature. In particular, we examined the extent to which SBT of 3rd-year medical students to proficiency standards in designated suturing and knot-tying skills, as measured by a composite score related to time, accuracy, and knot quality, improved their performance in such skills. We hypothesized that such a curriculum would enable all students to attain a minimal competency level related to designated suturing and knot-tying skills as measured by a composite score related to time, accuracy, and knot quality.

Methods

Training overview

From September 2013 to June 2014, all medical students rotating on the 3rd-year surgical clerkship completed a proficiency-driven, simulation-based knot-tying and suturing curriculum consisting of 6 tasks (Table 1). The LSU Health New Orleans School of Medicine has approximately 200 students enrolled within each class. Approximately 50 students rotate through each 12-week 3rd-year surgical clerkship block through the course of each academic year. Students had a large group introduction to the tasks with baseline testing during the 1st day orientation to the clerkship. They were then given practice kits for use at home and instructions regarding proficiency criteria to be attained. Over the course of the clerkship, they completed the curriculum, performing postintervention testing on the 6 tasks.

Training tasks, format, and equipment

The 6 tasks chosen for the curriculum were drawn from a previously published, proficiency-driven, simulation-based knot-tying and suturing curriculum originally developed for surgical residents at the University of Texas, Southwestern general surgery program.[12,13] This curriculum consisted of 12 knot-tying and suturing skills designed to standardize intern technical skill related to these basic tasks, and it has been shown to be effective in helping learners acquire these skills. In addition, a small number