

Surgical Education

A better way to teach knot tying: a randomized controlled trial comparing the kinesthetic and traditional methods



Emily Huang, M.D., M.Ed.^{a,*}, Hueylan Chern, M.D., FACS^a,
Patricia O'Sullivan, Ed.D.^b, Brian Cook, B.S.^c, Erik McDonald, B.S.^c,
Barnard Palmer, M.D., M.Ed.^d, Terrence Liu, M.D., FACS^d,
Edward Kim, M.D., FACS^a

^aDepartment of Surgery, University of California San Francisco, San Francisco, 513 Parnassus Avenue, S-321, San Francisco, CA 94143-0470, USA; ^bDepartment of Medicine, University of California San Francisco, San Francisco, CA, USA; ^cSchool of Medicine, University of California San Francisco, San Francisco, CA, USA; ^dDepartment of Surgery, University of California San Francisco-East Bay, Oakland, CA, USA

KEYWORDS:

Surgical education;
Knot tying;
Kinesthetic;
Technical;
Skill;
Basic skills

Abstract

BACKGROUND: Knot tying is a fundamental and crucial surgical skill. We developed a kinesthetic pedagogical approach that increases precision and economy of motion by explicitly teaching suture-handling maneuvers and studied its effects on novice performance.

METHODS: Seventy-four first-year medical students were randomized to learn knot tying via either the traditional or the novel "kinesthetic" method. After 1 week of independent practice, students were videotaped performing 4 tying tasks. Three raters scored deidentified videos using a validated visual analog scale. The groups were compared using analysis of covariance with practice knots as a covariate and visual analog scale score (range, 0 to 100) as the dependent variable. Partial eta-square was calculated to indicate effect size.

RESULTS: Overall rater reliability was .92. The kinesthetic group scored significantly higher than the traditional group for individual tasks and overall, controlling for practice (all $P < .004$). The kinesthetic overall mean was 64.15 (standard deviation = 16.72) vs traditional 46.31 (standard deviation = 16.20; $P < .001$; effect size = .28).

CONCLUSIONS: For novices, emphasizing kinesthetic suture handling substantively improved performance on knot tying. We believe this effect can be extrapolated to more complex surgical skills.
© 2014 Elsevier Inc. All rights reserved.

There were no relevant financial relationships or any sources of support in the form of grants, equipment, or drugs. The authors declare no conflicts of interest.

This manuscript is not submitted elsewhere for publication.

Abstract presented at the Northern California Chapter of the ACS Annual Meeting in San Francisco, CA, on June 8, 2013, and won a Best Clinical Investigation or Education Research Award. Abstract presented at the ACS Annual Clinical Congress in Washington, DC, on October 8, 2013.

* Corresponding author. Tel.: +1-609-936-0827; fax: +1-415-502-1259.

E-mail address: emily.huang2@ucsfmedctr.org

Manuscript received February 25, 2014; revised manuscript April 7, 2014

Surgical knot tying is almost always the first technical skill a surgical learner is requested to perform in the operating room. Learners approach this moment with excitement and trepidation, as the moment when they transition from being observers of surgery to being participants. For the learner (and the patient), this is also a high-stakes event: Demonstration of competence (or failure) both reflects on the learner's capacities and affects future participation opportunities in the operating room, whereas the performance of the knot-tying act affects, in however small a measure, the patient's actual surgical outcome. Optimally, preparing learners to perform basic surgical skills such as knot tying in vivo is thus an important goal of any basic surgical education program.¹

To address this goal, programs have made significant efforts to incorporate more basic surgical skills training into undergraduate medical education and early residency training,² as well as to standardize curricular materials and instructional pedagogies.³ Physical resource and time limitations in the form of duty-hours restrictions have also compelled considerable changes in graduate medical education over the last decade, necessitating development of ways to efficiently train surgical learners.⁴ Against the backdrop of this complex environment, the humble surgical knot provides a perfect focus for beginning to understand and improve the ways in which we think about teaching surgery.

Surgical knots must be of high quality to securely bind structures. A less obvious principle, particularly to novices, is that knots are simply the "products" of a "process" that must be executed with great precision and finesse. If a surgeon avulses a blood vessel in the process of ligating it by erratically pulling on the sutures, he has entirely defeated the purpose of the knot. Surgical educational materials have always emphasized the steps of the process, showing pictures of the spatial configuration of the hands and suture ends as a knot is formed, as well as the product, usually highlighting the final appearance of a square knot.⁵

How to form these spatial configurations in an atraumatic manner is a matter of "kinesthetics": finely attuned awareness of sensory input and control of motor output that is akin to body positioning and balance in sports. Expert surgeons intuitively perform suture-handling maneuvers to tie knots fluidly, but novices cannot learn these maneuvers without explicit instruction. An analysis of novice knot-tying errors by Rogers et al⁶ provides vivid illustration of this fact. They identified 4 common beginner errors (frequency):

1. Too much motion in right hand (38%),
2. Failure to maintain consistent tension (17%),
3. Hands too close to knot (13%), and
4. Failure to cross hands (7%).

Most of these errors stem from a single root cause: failure to obtain and then maintain a comfortable working distance from the knot. For example, novices often hold the suture ends too loosely and slide up on them, causing their

relative lengths to change. The tail end of the suture becomes too short to easily loop into knots, which results in fumbling, uneven tension, and the use of extra fingers to form the loop (the 2 most frequent errors, as observed by Rogers et al⁶). By teaching some key suture-handling maneuvers (*gathering*, *sliding*, and *locking*) and emphasizing kinesthetic awareness, we address these root causes of error and teach trainees to establish and maintain an ideal, balanced position from which it is easy to tie knots smoothly without excessive or erratic lifting, fumbling, and dropping of suture.

The kinesthetic curriculum⁷ incorporates a clear and concise practical glossary to improve communication between instructors and students and builds up on basic suture-handling ("pretying") maneuvers to show learners not only how to tie a knot but also how to manipulate the suture to lay it down precisely. The teaching manual and accompanying video provide step-by-step instructions with specific attention to the relevant details of setup, technique, and recovery. Because the method aligns with principles of cognition for deliberate practice in the acquisition of technical skills,⁸⁻¹⁰ we postulated that emphasizing kinesthetic suture handling would improve performance on knot tying, even over a very short instructional time. Furthermore, we believe that focusing on teaching kinesthetics in surgery can help trainees improve technical performance even on more advanced surgical skills. Therefore, we undertook this study to compare novice learners instructed using traditional versus kinesthetic methods.

Methods

We recruited first-year medical students from the University of California, San Francisco (UCSF) School of Medicine to participate in this randomized controlled study as part of a "basic surgical skills" elective. The study was performed under an institutional review board-exempted protocol. None of the students had any prior experience in knot tying or other surgical skills. The individual students were randomly assigned to 1 of the 2 groups: learning to tie surgical knots via the "traditional" or "kinesthetic" methods before beginning the elective.

All students attended a 2-hour knot-tying teaching session in the Surgical Skills Center with expert faculty instructors who had previously been identified as strong teachers. The traditional method group was taught by faculty who had never previously been exposed to the kinesthetic method to avoid any potential bias, and followed teaching principles from the American College of Surgeons Surgical Skills Curriculum for Residents.⁵ The kinesthetic method group was taught by faculty familiar with the kinesthetic method, and followed kinesthetic teaching principles.⁷ Both groups received the same amount of face-to-face instructional time, and the average instructor to student ratio was 1:6. After the initial instructional session, students were provided with links to instructional YouTube videos to promote

Download English Version:

<https://daneshyari.com/en/article/4278980>

Download Persian Version:

<https://daneshyari.com/article/4278980>

[Daneshyari.com](https://daneshyari.com)