

## Suture Education with Soft-Embalmed Cadavers: A Cut Above the Rest

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### ABSTRACT

**Introduction.** The efficacy of a surgical skills curriculum was assessed for third-year medical students focused on suturing training on soft embalmed cadavers, which simulate natural tissue more effectively for surgical procedures than traditionally preserved cadavers or surgical practice pads.

**Methods.** A retrospective cohort study compared pre- and post-survey results at a premier, accredited, nationally ranked academic medical center. Study participants were third-year medical students completing their required surgical clerkship rotation who participated in suturing sessions on both synthetic suture practice pads and soft-embalmed cadavers prior to beginning their operating room experience.

**Results.** A total of 40 participants were included, with slightly more male participants. The majority of participants (52%) were interested in pursuing a non-surgical career. After participating in Clinical Anatomy Mentorship Program (CAMP), participants felt significantly more confident in their ability to suture in the operating room (median 4 [3-4] vs. 2 [1-3],  $p < 0.001$ ); in their knowledge of basic suturing supplies and instruments (median 4 [4-4] vs. 3 [2-3],  $p < 0.001$ ); and in their ability to determine when different suture techniques are appropriate in the operating room (median 3 [3-4] vs. 1 [1-2],  $p < 0.001$ ). Participants felt more confident in their ability to suture in the operating room after their experience suturing on soft-embalmed cadavers compared to suture practice pads (median 5 [4-5] vs. 4 [4-4],  $p = 0.002$ ).

**Conclusions.** Medical students' confidence in suturing skills and in the knowledge of important characteristics of suturing practice was improved significantly after a suture training session on soft-embalmed cadavers. *Kans J Med 2022;15:78-81*

### INTRODUCTION

Suturing is a critical skill that physicians need to be able to perform confidently and proficiently. The foundation of this skill is best built early in training, often during medical school.<sup>1</sup> In fact, suturing is one of the most common procedural skills for medical students to perform during their clinical rotations. Yet, medical students often experience a significant amount of anxiety when asked to suture wounds.<sup>2</sup> Formal training sessions for medical students are known to increase both student confidence and skill with suturing.<sup>3-5</sup>

An ideal strategy for developing procedural skills is to practice with material that simulates living tissue as closely as possible. It previously has been demonstrated that medical students' type of practice material has a notable impact on suturing skills acquisition.<sup>6</sup> Cadaveric tissue has been an excellent choice for trainees to learn and practice a wide variety of procedural skills.<sup>6-13</sup> Soft embalmed cadavers, which are cadavers preserved in a more lifelike manner than traditionally preserved cadavers, simulate natural tissue more effectively for surgical procedures than

traditionally preserved cadavers.<sup>6-19</sup> With these known benefits of soft-embalmed cadavers in medical trainee procedural skills practice, medical students would benefit greatly from practicing their suturing skills on soft-embalmed cadavers prior to suturing in the operating room.

We hypothesized that medical students will feel more confident in their suturing skills and knowledge of suturing principles after participation in suturing practice on soft-embalmed cadavers. Secondly, participants will attribute their confidence in suturing more to their experience suturing on soft-embalmed cadavers than their experience suturing on synthetic suture practice pads.

### METHODS

**Study Design.** A retrospective cohort study was performed to evaluate the hypotheses. All aspects of this study were approved by a duly constructed Institutional Review Board at our institution prior to commencement of any study activity. Data utilized for this study were collected via surveys as part of the Clinical Anatomy Mentorship Program (CAMP), a near-peer surgical education program for medical students at our institution. Data collected from CAMP and analyzed in this study were collected from May 2021 to July of 2021. The Institutional Review Board at our institution approved this secondary use of regularly collected CAMP data for use in this study without the need to obtain informed consent from each prior participant in CAMP. Therefore, informed consent for each previous participant in CAMP was not needed nor pursued for study activity.

**Surgical Skills Curriculum.** During CAMP, the third-year medical students participate in a full-day anatomy and surgical skill workshop prior to their surgery clerkship. Participants are taken through demonstrations of common surgical procedures in general surgery and various surgical subspecialties, practice foundational laparoscopic techniques, and practice suturing on soft-embalmed cadavers. During this suturing practice, participants practice a myriad of methods, including simple interrupted, simple running, interlocking, horizontal mattress, vertical mattress, buried, subcuticular, 1-hand tie, and 2-hand tie techniques. These skills are taught by fourth-year medical students who have received training by expert surgeons on how to teach fundamental suture skills effectively to their peers. This concept is termed near-peer teaching in CAMP at our institution. The same group of students participated in a suture practice session on practice pads earlier that week, where they were introduced to the techniques mentioned above.

**Assessing Curriculum Efficacy.** A pre-survey was distributed to students before they participated in CAMP, and a post-survey was distributed to participants after participation in CAMP as part of the program. These surveys collected information from students on many topics, ranging from anatomy knowledge to medical student perceptions of surgery, to suturing. The survey responses that focused on suturing were collected for use in this study. These questions were developed in a Likert scale format to assess students' confidence in suturing in the operating room, perceived knowledge of suturing instruments and

appropriate suture techniques, and the impact of their experiences suturing on both suture practice pads and soft-embalmed cadavers. While not validated, these questions were constructed by CAMP directors, including active surgeons and experts in medical student education. Student responses to these questions were collected for analysis in this study.

**Statistical Analysis.** Statistical analysis was performed using IBM® SPSS® Statistics software (Version 26.1). Baseline participant characteristics were analyzed as frequencies utilizing medians and interquartile ranges. Comparison of participant responses to Likert scale questions between the pre- and post-survey, as well as a comparison of questions within the same survey, were accomplished via the Wilcoxon Signed Rank test. Statistical significance was set at  $p < 0.05$ .

### RESULTS

Table 1 presents the summary statistics for baseline information describing our study participants. A total of 40 third year medical school participants were included with an average age of 25 years. There were slightly more males than females included (52% male). The majority of participants (52%) were interested in pursuing a non-surgical career.

**Table 1. Participant characteristics.**

Baseline participant characteristics	n = 40
Age*	25 [24-28]
Gender	
Female	19 (48%)
Male	21 (52%)
Career interest	
Surgical	19 (48%)
Non-surgical	21 (52%)
Prior operating room experiences	
Yes	37 (93%)
No	3 (7%)

\*Median [interquartile range]

Selected pre-and post-survey results are displayed in Table 2. After participating in CAMP, participants felt significantly more confident in their ability to suture in the operating room (median 4 [3-4] vs. 2 [1-3],  $p < 0.001$ ), in their knowledge of basic suturing supplies and instruments (median 4 [4-4] vs. 3 [2-3],  $p < 0.001$ ), and in their ability to determine when different suture techniques are appropriate in the operating room (median 3 [3-4] vs. 1 [1-2],  $p < 0.001$ ). Notably, participants responded that they felt more confident they would seek out opportunities to suture in the operating room after participating in this program (median 4 [4-5] vs. 4 [3-4],  $p = 0.009$ ).

Table 3 displays the difference in participants' confidence gained from practicing on both suture pads and soft-embalmed cadavers. Participants felt more confident in their ability to suture in the operating room after their experience suturing on soft-embalmed cadavers compared to suture practice pads (median 5 [4-5] vs. 4 [4-4],  $p = 0.002$ ).

**Table 2. Comparison of pre- and post-survey results.**

Survey questions	Pre-survey median Likert scale response*	Post-survey median Likert scale response*	p value
I am confident in my ability to suture in the operating room.	2 [1-3]	4 [3-4]	$< 0.001^{**}$
I am confident in my knowledge of basic suturing instruments and supplies.	3 [2-3]	4 [4-4]	$< 0.001^{**}$
I am confident in my ability to determine when different suture techniques are appropriate in the operating room.	1 [1-2]	3 [3-4]	$< 0.001^{**}$
I am confident I will seek out opportunities to suture in the operating room.	4 [3-4]	4 [4-5]	0.009**

\* Median [interquartile range]

\*\*  $p < 0.05$ , statistically significant

**Table 3. Comparison of responses in the post-survey.**

	Practicing suturing on suture practice pads improved my confidence to suture in the operating room.*	Practicing suturing on soft-embalmed cadaver tissue improved my confidence to suture in the operating room.*	p value
Scores	4 [4-4]	5 [4-5]	0.002**

\* Median [interquartile range]

\*\*  $p < 0.05$ , statistically significant

### DISCUSSION

This study evaluated the primary hypothesis that medical students would feel more confident in their suturing skills and knowledge of key suturing principles after utilizing soft-embalmed cadavers compared to synthetic suture practice pads to practice this skill. Additionally, we hypothesized that students who gained confidence in their suturing skills after practicing on both materials would attribute this increase in confidence more to their experience with soft-embalmed cadaver tissue compared to practice on synthetic suture practice pads. The first major finding of this study was that medical student confidence in their suturing skills and their knowledge of vital characteristics of suturing practices improved significantly after a suture training session on soft-embalmed cadavers compared to their confidence and knowledge after practicing suture skills on synthetic suture practice pads. Our medical students attributed their gain in suturing confidence to their experience with soft-embalmed cadavers, as compared to synthetic suture practice pads.

This study added to the numerous examples in the literature of the superiority of soft-embalmed cadaver tissue for education of medical trainees compared to alternatives. While not all focused on suture skills, there has been clear benefit in educating medical students on a variety of procedural skills.<sup>7,8,16-18</sup> These benefits are evident in improving resident procedural skills utilizing soft-embalmed cadavers as well.<sup>7,9-12,15</sup> Gonzalez-Navarro et al.<sup>6</sup> conducted a study focused on determining the ideal suturing model for medical students to practice suture skills.

This investigation determined that medical students preferred practicing suturing on pork fat tissue compared to sponges, oranges, or commercially available suture practice models. While our study did not investigate each of these different materials and the Gonzalez-Navarro et al.<sup>6</sup> study did not include soft-embalmed cadaver tissue, both studies had similar findings in that the true tissue was superior to the synthetic and non-human/animal alternatives.

A notably relevant prior study was conducted by Guler et al.<sup>19</sup> to compare midwifery student confidence in repairing episiotomy with suturing after practicing with both cow tongue tissue and synthetic suture practice models. This investigation determined that students' confidence in their ability to repair an episiotomy was significantly higher after practice with the cow tongue tissue compared to the synthetic model. Our findings that students' confidence in their ability to suture was greatest after practice with and primarily due to their practice with soft-embalmed cadaver tissue was similar with these findings.

The importance of increasing both medical student confidence and proficiency with suturing should not be overlooked. As medical students often are asked to perform suturing in the operating room,<sup>1,2,5</sup> educating them in this skill in the most ideal way is paramount. At our institution, it is common for medical students to close the majority of surgical incisions on many surgical services. While that cannot be generalized to all other healthcare facilities, it is likely that medical students participate in the operating room in some capacity. Importantly, the operating room is likely not the ideal place for a medical student to learn and practice how to suture for the first time. Medical students viewed the operating room as a less ideal place to learn various technical surgical skills initially compared to attending surgeons.<sup>20</sup> Medical students often viewed suturing on patients in the operating room as an anxiety-ridden experience.<sup>2,5,20,21</sup> Clearly, there needs to be greater focus on providing high-quality instruction and practice material for medical students to develop their suturing skills prior to performing suturing on a patient in the operating room. It has been demonstrated previously that early suture training programs for medical students prior to their introduction to the operating room benefits their technical skills and confidence in these abilities.<sup>3-5,22</sup> Combining early acquisition and repetition of suture skills with high quality soft-embalmed cadaver tissue that is far more realistic to patient tissue than synthetic alternatives likely will benefit medical student operating room experience, technical skill in the operating room, and care of the surgical patient.<sup>7-13</sup>

One necessary element to consider with soft-embalmed cadavers is the financial need to secure and properly maintain these cadavers. There are increased costs to procure and maintain soft-embalmed cadavers compared to suture practice pads as various chemicals, deep freeze storage space, and support personnel is required.<sup>14</sup> In our experience, soft embalmed cadavers cost approximately \$1,300 per body to obtain and maintain for one year and it was within the capacity of our anatomy laboratory to maintain these bodies with deep freezer capacity. These cadavers were viable for an entire academic year.

Consumer available suturing pad cost varied widely, as did the quality of the pads themselves. Notably, many of these synthetic suture practice pads can be used for years. Some may view this as justification for providing suturing pads as practice, however, our results add to the multi-faceted decision of providing ideal training opportunities for

medical students to the need for cost consideration of such ventures. A key point of this decision was that a soft-embalmed cadaver used for medical student suture education can be utilized by different specialties for additional education, thus increasing the utility of each cadaver and making the investment in soft-embalmed cadavers more justifiable.<sup>23</sup> The most important limitation with the pads, in our experience, was the inability for learners effectively to practice buried and subcuticular suture techniques on synthetic suture practice pads. Those techniques are challenging to practice on anything but true tissue. It was the experience of many students at our institution that these were also the two most common suture techniques that they were asked to perform in the operating room. Through the suture practicing on soft-embalmed cadavers during the CAMP sessions, students effectively practiced these techniques that were asked of them most commonly in the operating room.

There were important limitations to discuss with our results. First and foremost, this study was limited by small sample size. While a series of 40 medical students was sufficient to investigate our hypothesis with a significant result, it was possible that our findings may not be consistent with larger samples of medical trainees. Secondly, we were not able to assess our hypothesis using a true control group. Suture education on soft-embalmed cadavers was already the standard educational method at our institution, and as this study was non-interventional, we were limited in this capacity. However, we believed our hypothesis still was assessed adequately by sending the pre-survey prior to student participation in this suturing session. Secondly, the primary aim of this study did not seek to define whether the students' technical skill was improved, but rather their confidence with their suturing skill. As there could be mismatches between participants' confidence in suturing and their suturing skill, our results and conclusions could not assess true skill in suturing.

Notwithstanding these limitations, this study suggested soft-embalmed cadavers provide a benefit to medical student education regarding suture technique and knowledge prior to operating room experience. Further work is required to establish the viability of our results regarding student confidence and understanding of the benefit of utilizing soft-embalmed cadavers in this fashion. A natural progression of this work is to investigate student proficiency with suture technique with the use of soft-embalmed cadavers, stepping beyond just student confidence in their preparedness to suture.

## CONCLUSIONS

Although there was increased cost associated with supplying and maintaining soft-embalmed cadavers properly compared to cheaper, more convenient alternatives, such as suture practice pads, improving medical students' confidence in and knowledge of suturing with far more realistic simulation will benefit both the students and their patients. Medical students frequently were called upon to suture, heightening the importance of improving education in this area. While not addressed in this study, investigating the impact of soft-embalmed

cadavers on medical students' technical skills with suturing is a logical next step in addressing this educational need. We also would like to investigate whether our training session impacts the amount of hands-on suturing experience students achieve in the operating room during the surgery clerkship.

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