Student Mentoring to Enhance Suturing Proficiency in a Medical Curriculum

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Abstract

Background: Teaching fundamental skills such as suturing varies between medical teaching institutions. Despite great expectations from medical students, they are often left on their own for learning these skills, which sometimes takes place during a clerkship. We aimed to evaluate the efficiency of a suture curriculum based on simulation teaching considering the potential effect of role modelling during clinical practice.
Methods: All third-year medical students at our university were enrolled in a suture curriculum that comprised two simulation sessions. Proficiency was evaluated using a purposefully devised suture Objective Structured Assessment of Technical Skills (OSATS) score. After randomization, some participants were selected to perform sutures on patients with mentoring between the two sessions during a clerkship, and they constituted the clinical group.
Results: A total of 254 participants met the inclusion criteria. The overall performance in the second session was statistically better compared with the first session. The clinical group (78 students) performed significantly better in terms of OSATS scores (32.3 [30-33] vs. 30.2 [21-33]; P<0.001) and the completion time (64 [25-131] vs. 96 [29-360] seconds; P=0.006) compared with the control group. We found a significant association between perception of positive role model and performance (P=0.012).
Conclusion: This study demonstrated the effectiveness of a simulation curriculum for suture proficiency with the reinforcing effect of mentoring during a clerkship. Simulation as part of the medical curriculum is only effective if it is integrated in clinical practice to achieve situated learning.
Keywords: TECHNICAL SKILL, SUTURING, MENTORING, ROLE MODEL, SITUATED LEARNING

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Introduction

Fundamental technical skills such as suturing and knot tying are used in a wide range of medical specialties. Acquiring a strong and early proficiency in this area is seen as a key component in the curriculum of medical students. Medical students enrolled in sub-internships have indicated that technical skill development is one of the greatest benefits of the sub-internships experience (1). To respond

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to this "high expectation" of medical students, a simulation-based knot tying and suturing curriculum was recently implemented for all the third-year medical students at Limoges University of Medicine.

The aim of the surgical educators was to provide each student the possibility of attaining a minimal level of competency regarding the basics of suturing. A proficiency-driven curriculum was designed for medical students before they started clerkship. Good acquisition of the skills can be achieved by allowing a minimum of three attempts at each task (2). A recent study showed a statistically significant gap between student's perceived and desired competency regarding suturing (3). To avoid this negative perception, appropriate teaching methods were used, such as an increased student/instructor ratio of at least 4/1 (4), verbal feedback (5), self-directed learning (6), and support by supplemental video instruction (7). To enhance the appeal of the sessions, a positive skill competition was held among participants (8).

In addition to responding to the students' expectations, the aim of this curriculum was to promote the acquisition of skills and their long-term retention. In terms of long-term retention, it is known that single interventions to teach surgical skills are not sufficient (9). As many institutions cannot offer more than one introductory suturing course in a single academic year, we considered the potential benefits of technical practice during a clerkship to promote the acquisition of these skills. Given the importance of role-modelling for technical skills during medical curriculum (10, 11), supervised suturing was organized with the consultants. We hypothesized that the experience of supervised suturing of patients during a clerkship soon after the initial simulation session would have a positive effect for retention of basic suturing skills.

The primary endpoint was evaluating the effect of clinical practice with the potential effect of role-modelling on the acquisition and retention of knot tying and suturing skills. The secondary endpoint was evaluating the effectiveness of the suture curriculum.

Methods

1. Study Design and Participants

This prospective study included medical students from the 2017-2018 and 2018-2019 academic years at our University Hospital, France. From September 2017 to May 2019, medical students completed a suture curriculum. Exclusion criteria for this study were prior knot, suturing, or surgical experience. The experimental protocol was approved by the Ethics Committee of our institution (Number 283-2018-49).

2. Experimental Protocol

The entire curriculum was performed at the medical simulation facility of our institution. Each class was divided into small groups of no more than 15 participants. The students were verbally briefed regarding the risks and benefits of the study and they provided oral consent to participate. Each group was supervised by a senior surgeon, an assistant surgeon, and at least two fellow surgeons. Each instructor was assigned a pair of students. For each group, the curriculum was divided into two sessions: session 1 (S1) in September; 4 hours and session 2 (S2) in May; 2 consecutive hours.

For S1, the instruction included an explanation of the entire curriculum, expectations, and the contents of the suturing kit. All of the participants completed a pre-intervention questionnaire containing sections about demographic parameters and prior experience with suturing. An introduction to knot tying and suturing skills was performed with a combination of directed instructions and tutorial videos. These didactic video support materials were created to explain how to perform a simple suture and they were made accessible to all of the students through the institutional website. The participants were asked to review the OSATS (Objective Structured Assessment of Technical Skills score) scoring sheet so that they were familiar with how they would be evaluated. At the end of the session, the performance of each

participant was evaluated using this scoring system with respect to interrupted sutures.
For S2, the participants were evaluated first in terms of their ability to perform an interrupted suture. They were then given instructions about other skills. At the end of the session, a skills competition was held to rate their interrupted suture skills. They were then asked to complete an anonymous satisfaction questionnaire.
After S1, all of the students underwent two rounds of 6-week clinical rotations for various medical specialties at the University Hospital between November and February. A group of students was selected after randomization to perform suturing on patients during the clerkship. These suture procedures were supervised by a single senior surgical practitioner of the corresponding department. This group of students is referred to here as the "clinical group". The students who did not receive supervised suturing practice during their clerkship are referred to here as the "control group".

3. Training Tasks and Evaluation

The participants were taught 12 knot-tying and suturing skills suitable for medical students (12). The sutures were performed using a dry material simulation kit (13) with surgical instruments and 4/0 polypropylene thread (PROLENE; Ethicon) with a 17-mm half-circle needle. The participants performed each task at least three times before the completion time was recorded. The participants practiced the simple suture procedure at least 10 times. At the end of S1, evaluation of this task was performed using an OSATS score (14) adapted for wound closure (15).
At the beginning of S2, an evaluation of the previous task was performed under the same conditions and the completion time was recorded. The participants were then taught other skills with this application such as draining or placing a catheter. At the end of S2, a competition was held based on performing an interrupted suture including at least a standardized one-point suture with a knot. The time for overall completion was recorded for the participants who performed a knot with a standard quality, and this is referred to here as the "competition time". The difference between the completion time at the beginning of S2 and the competition time was considered to be an indication of the capacity of each participant for progression and it was calculated as a percentage value.
At the end of S1 and S2, a satisfaction questionnaire was completed anonymously. Participants had to specify their perceived role models and the domain in which they perceived learning gains: knowledge, suture proficiency, and self-confidence. Then, they stated the extent to which they believed their learning gains were related. It was an 8-item survey on self-confidence using a 4-point Likert scale (1=definitively no to 4=definitively yes).
The performances of the participants with or without clinical suturing activity were compared. Statistical analysis was conducted using an unpaired t-test to compare the OSATS and completion times. Differences between the number of perceived role models were analyzed with Wilcoxon's signed-rank test. Associations between perceptions of role models and students' ratings were analyzed by Spearman's rank correlation coefficient (ρ). Data analysis was performed with Prism 8 Mac software (GraphPad software; San Diego, California, USA).

Results

A total of 259 third-year medical students were included in the curriculum. Five were excluded due to insufficient data. Of the 254 participants, 21 were left-handed, and 154 were women. In the clinical group, 78 performed supervised suturing on patients with a mean number of 3,2 procedures (2-11).
For S1, there was no difference between female/male or left/right-handed groups of students. No statistically significant difference was found between the clinical and the control groups. The participants generally performed better in S2 compared to S1 (Table 1) without a significant overall difference. Of note, a statistical difference

was observed for the clinical group in terms of the completion time between S1 and S2 (97 (45-380) vs. 64 (25-120) seconds; P<0.01). For S2, the students who had the opportunity to practice during their clerkship performed significantly better in terms of their OSATS score (32.2 [30-33] vs. 30.2 [21-33]; P<0.001) and the completion time (64 [25-131] vs. 96 [29-360] seconds; P=0.006) compared with students who did not have such practice. Similarly, the quality of the overall appearance was statistically better (4.8 vs. 4.1; P<0.01) for the students who had undergone clinical practice. With respect to competition time, the rate of improvement was better overall for the participants who did not have clinical suture practice (29.8 [-19-73] %

Table 1: Comparison of performances between session 1 and session 2

Performances comparison between session 1 and session 2						
Variable	**S1 Completion time (seconds)**	**S2 Completion Time (seconds)**	**P value**	**S1 OSATS Score**	**S2 OSATS Score**	**P value**
Total group (n=254) mean (SD)	97 (65)	90.8 (55)	0.57	31.2 (1.3)	30.8 (1.6)	0.34
Clinical group (n=78) mean (SD)	97 (64)	64 (22)	<0.01	31.3 (1.2)	32.3 (0.8)	0.06
Control group (n=176) mean (SD)	96 (66)	96 (62)	0.90	31.1 (1.3)	30.2 (2.3)	0.25

OSATS: Objective Structured Assessment of Technical Skills; S1: session 1; S2: session 2

Table 2: Comparison of clinical and control group during session 2

Performances comparison of clinical and control group during session 2				
Groups	**Total group (n=254) mean (SD)**	**Clinical group (n=78) mean (SD)**	**Control group (n=176) mean (SD)**	**P value**
Completion Time (seconds)	90.8 (5.3)	64 (2.1)	96 (6.3)	<0.01
Competition Time (seconds)	46.2 (2.0)	38 (1.9)	47 (1.5)	<0.01
Improvement rate (%)	37.6 (2.2)	29.8 (8)	38.9 (1.7)	0.11
OSATS score	30.6 (0.1)	32.2 (0.8)	30.2 (2.2)	<0.001
Overall appearance	4.2	4.8	4.1	<0.01

OSATS: Objective Structured Assessment of Technical Skills; S1: session 1; S2: session 2

Table 3: Summary mean statistics for student satisfaction with the content, quality and usefulness of suturing curriculum

Summary mean statistics for student satisfaction with the content, quality and usefulness of suturing curriculum					
Item	***Mean total Score**	**+/- SD**	**Clinical group**	**Control group**	**P value**
I understood clearly what I was expected to do	3.53	0.35	3.52	3.54	0.58
Degree of difficulty of learning	1.26	0.50	1.28	1.31	0.21
I understood the fundamentals of suturing	3.64	0.54	3.65	3.64	0.74
The content of the curriculum was relevant for my professional development as a physician	3.92	0.20	3.94	3.91	0.43
The curriculum was organized well	3.37	0.51	3.37	3.38	0.56
Teaching methods were effective for my learning	3.34	0.52	3.36	3.32.	0.11
How confident do you feel for suturing after this curriculum?	3.75	0.77	3.88	3.62	0.04
Completing this curriculum makes me more likely to suture in the future	3.16	0.89	3.43	2.81	0.03

*Definitively no=1 to definitively yes=4

Table 4: Comparison of perceived role-modelling (mean, SD) by students for each domain during clerkship

Domain	*Perceived as positive			*Perceived as negative		
	Clinical group mean (SD)	Control group mean (SD)	P value	Clinical group mean (SD)	Control group mean (SD)	P value
Knowledge	3.2 (1.2)	2.1 (1.6)	<0.05	0.4 (0.3)	0.5 (0.8)	1.2
Suture proficiency	3.5 (1.4)	2.3 (1.5)	<0.01	0.1 (0.2)	0.2 (0.2)	0.71
Self-confidence	3.4 (0.6)	2.2 (1.1)	<0.01	0.5 (1.2)	0.8 (1.1)	0.82

*Definitively no=1 to definitively yes=4

vs. 38.9 [-0.18-0.84.3] %; P=0.11) (Table 2). We did not find any correlation between the winners of the competition and the clinical practice.

Table 3 lists the mean satisfaction scores for the students' perception of the relevance and quality of this curriculum. No satisfaction difference was found between the clinical and control groups. Perceived role modelling was positive and statistically superior for each domain (Table 4). A significant association between the perception of the senior as a positive role model and the OSTAS performance of the students (ρ=0.312, P=0.012) was found in the clinical group. No significant association was found between the perception of role models and performances in the control group.

Discussion

This study highlights the importance of the clinical practice for skill retention during the medical curriculum. It confirms the complementarity between simulation and clinical teaching and the potential effect for education. The results showed that using a proficiency-driven and simulation-based curriculum led to higher retention of suture acquisition. There was an increased retention effect secondary to an intermediate supervised clinical practice. The results emphasize that this curriculum was considered to be a major step forward in their professional development as physicians. In this study, there were comparable scores for the S1 and S2 sessions for the entire group. This first point underlines the efficiency of simulation teaching concerning medium-term retention. Moreover, this retention effect was reinforced by the clinical practice, as indicated by the significant difference between the clinical and control groups. To the best of our knowledge, this is the first study to show the effect of clinical practice during a clerkship for suturing proficiency. We believe that our results indicate that a single instructional session followed closely by clinical practice of clinical suturing may yield good results in terms of skills retention. For S2, the clinical group had significantly better scores than the control group for the competition component, but the rate of improvement was lower. The potential effect of skill retention by clinical practice may entail a lesser capacity for improvement during the second session. In other words, the simulation tool can partially make up for the lack of clinical implementation.

It is widely recognized that situated learning is important for teaching technical competence. The present results demonstrate that pure technical skills are reinforced by mentoring during a hospital clerkship compared with the absence of mentoring. The aim of this mentoring was to promote the effect of role modelling-making (16). Senior surgical practitioners were favored in order to reach a degree of mature awareness given the subsequent influence on students. The didactic quality of this mentoring involves coaching, feedback, and supervision (17). The intended goal was to promote reflection by teachers and the effect of teachers' practices on learners (18). The perceived role modelling was hence positive for both groups and was reinforced for the clinical group. The role model's behavior could be improved by direct supervision (19). The retention for both groups was generally good, with or without intermediate active suturing.

Indeed, active observation during a clerkship can stimulate the unconscious incorporation of behaviors and promote the acquisition of personal qualities or technical skills. Vicarious learning during clinical practice is perhaps as effective as hands-on training, as in the case with pure simulation learning (20). The intrinsic motivation of students can also be stimulated by preclinical suture training (21). This study confirms the necessary complementarity between situated learning during a clinical clerkship and a theoretical teaching framework by simulation. According to the self-confidence questionnaire, this curriculum resulted in a Kirkpatrick's level 2 effectiveness: the participants liked the training and they learned skills related to this training (22). Given the skill retention effect, the global positive perception of role-modelling for both groups and its association with better performance in the clinical group, these considerations were very encouraging points for the team of preceptors.

A potential limitation of this study was its inability to prove a long-term clinical retention effect. As both of the groups underwent a clinical clerkship with a potential role-modelling effect, it was difficult to evaluate the actual impact of active mentoring supervision in terms of retention. Additional studies are needed to prove this. This could be done, for example by comparing the proficiency at performing clinical sutures of residents with different simulation curricula.

Conclusion

This study demonstrated the efficiency of a simulation curriculum for the development of proficiency with suturing, with the reinforcing effect of mentoring during a clerkship. Simulation, as part of the medical curriculum, is effective if integrated in clinical practice to promote bona fide situated learning. The results of the self-confidence questionnaire argue that this suture modality teaching was crucial for the professional development of the students as physicians. Role-modelling was also a core component for technical skills. Reflective teaching during simulation and active observation during clinical practice may lead to expected positive retention.

Conflict of Interest: None Declared.

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