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Virtual teaching of surgical sutures for undergraduate human medicine students during the COVID-19 pandemic

Consuelo E. Cornejo Carrasco

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VIRTUAL TEACHING OF SURGICAL SUTURES FOR UNDERGRADUATE MEDICAL STUDENTS DURING THE COVID-19 PANDEMIC.

ENSEÑANZA VIRTUAL DE LAS SUTURAS QUIRÚRGICAS PARA ESTUDIANTES DEL PREGRADO DE MEDICINA HUMANA DURANTE LA PANDEMIA DE COVID-19

Consuelo Elsa Cornejo-Carrasco [1,2,a]

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ABSTRACT

Introduction: Education in suture surgical procedures is essential and has been a challenge during the COVID-19 pandemic. **Objective:** To determine the level of development of the technical skills of the medical student in performing surgical sutures through the virtual teaching model. **Methods:** A retrospective, descriptive and longitudinal study was carried out that evaluated the skills achieved by 24 fifth-year medical students with no previous knowledge of surgery to perform surgical sutures (simple and cruciate stitch) through virtual teaching of the course of operative technique (virtual classrooms, synchronous videoconferences, inanimate, and ex vivo and telementoring). **Results:** Concerning the simple point, there was a significant improvement in the OSATS guidelines (objective structured assessment of technical skills) from 6±0.28 to 28±2.6 as well as the completed suture rubric from 5±0.28 to 24±1.5 and a decrease in time to perform the suture from 44±13 seconds to 33±9 seconds, at the end of the course ($p<0.001$). In relation to the cruciate-stitch, a significant improvement was found in the OSATS score from 6±0.28 to 27±2, as well as in the completed suture from 5±0.28 to 24±1.7 and a decrease in the time in performing of suture from 66±21 seconds to 56±11 seconds, in favor of the post-test ($p<0.001$). **Conclusions:** There is an adequate development of skills of medical students to perform the simple and cruciate points through the proposed virtual teaching model.

Keywords: Suture techniques, clinical competence, simulated training, educational models, medical students, educational virtual reality. (Source: MeSH NLM).

RESUMEN

Introducción: La educación en técnicas de suturas quirúrgicas es esencial y ha sido un reto durante la pandemia por COVID-19. **Objetivo:** Determinar el nivel de desarrollo de las competencias técnicas del estudiante de medicina en la realización de suturas quirúrgicas mediante el modelo de enseñanza virtual. **Métodos:** Se realizó un estudio retrospectivo, descriptivo y longitudinal que evaluó las competencias logradas de 24 alumnos del quinto año de medicina, sin conocimiento previo de cirugía, para la realización de suturas quirúrgicas (punto simple y cruzado) mediante la enseñanza virtual del curso de técnica operatoria (aulas virtuales, videoconferencias sincrónicas, modelos de simulación inanimada y ex vivo y la telementoria). **Resultados:** Con relación al punto simple, hubo mejoría significativa en las pautas OSATS (objective structured assessment of technical skills) de 6±0,28 a 28±2,6 así como la rúbrica de la sutura finalizada de 5±0,28 a 24±1,5 y disminución del tiempo en la realización de la sutura de 44±13 segundos a 33±9 segundos, al finalizar el curso ($p<0,001$). Con relación al punto cruzado, se encontró mejoría significativa en el puntaje OSATS de 6±0,28 a 27±2, así como de la sutura finalizada de 5±0,28 a 24±1,7 y disminución del tiempo en la realización de la sutura de 66±21 segundos a 56±11 segundos, a favor del post-test ($p<0,001$). **Conclusiones:** Existe un adecuado desarrollo de competencias de los estudiantes de medicina para la realización del punto simple y cruzado mediante el modelo de enseñanza virtual propuesto.

Palabras claves: Técnicas de sutura; Competencia clínica; Entrenamiento simulado; Modelos educacionales; Estudiantes de medicina; Realidad virtual educativa. (Fuente: DeCS BIREME).

[1] Universidad Ricardo Palma. Lima Peru.
[2] Edgardo Rebagliati Martins National Hospital. Lima Peru.
[a] General Surgeon, Doctor in Public Health.

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INTRODUCTION

Competency-based education is considered the most important and far-reaching revolution in medical education for the 21st century [1]. The surgical suture technique is essential and is part of the general practitioner's skills[2,3].

The teaching of surgical sutures is carried out in all medical schools in our country through the surgery-operative technique, carried out in person in laboratories with inanimate simulation models and in experimental animals. The student acquires the technical skills through a tutorial model, where the professor teaches and supervises the procedure while the students learn and perform the sutures. This face-to-face tutorial model could not be carried out during the COVID-19 pandemic since face-to-face classes were suspended in schools, institutes, and universities to prevent the spread of SARS-CoV-2.

Almost none of the institutions was prepared to face the crisis in medical training programs as a result of the pandemic, where there was a severe impact on the surgical training of all resident doctors of the different surgical specialties [4], as well as of medical interns and undergraduate students [5]. Therefore, one of the main challenges we had to face as teachers was to offer structured learning strategies in virtual environments and with distance learning resources [6,7], not only for theoretical classes but also for practical classes; the latter being the cornerstone of teaching in surgery and operative technique.

There are studies concerning the education of surgical sutures to undergraduate medical students in simulated models, where the practical and theoretical classes are face-to-face [8,9]. There are also publications where the practical classes were face-to-face, while the theoretical classes or videos of the procedures were published in the virtual classroom [10,11]; however, there were no published studies where the practical sessions were virtual; so the professor should use his ingenuity and creativity to develop new methodologies and innovative learning strategies beyond traditional teaching.

At the beginning of the pandemic, in March 2020, a virtual education model was created in the operative technique course for undergraduate medical students at Ricardo Palma University. The objective was to determine the level of development of technical skills in performing surgical sutures.

METHODS

Study design type and area

A descriptive, retrospective and longitudinal study was carried out in a private medical school in Lima, Peru.

Population and sample

The population was all undergraduate students in the fifth year of human medicine who were going to start the course of surgery - operative technique and anesthesiology, who were assigned by lottery to a practice group, which had between seven to nine students by rotation and one teacher during 2020.

The type of sampling was census since all the students assigned to the research teacher who received the same methodology of this new virtual teaching model and met the inclusion and exclusion criteria were included.

The inclusion criteria were:

-Students with no previous experience in surgical sutures in any simulation model (inanimate and alive) or any patient.

-With little or no knowledge of surgical sutures

Exclusion criteria were:

-Did not complete the assessments.

-It was impossible to verify the test record of all the evaluations of their competencies.

During the study period, the research professor was assigned 33 students, of which 24 met the inclusion and exclusion criteria described. The reasons for the excluded students were: one did not complete the evaluations, two had experience performing sutures, and six the complete records of their evaluations could not be verified. The participating students were from three rotation groups in 2020, and each group had eight students.

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Variables and instruments

In this study, the records of the evaluations of the skills achieved (rubrics and operative times) in surgical sutures (single stitch and cruciate stitch) with the new virtual teaching model of the operative technique course of all the students without prior knowledge were reviewed in performing surgical sutures, assigned to the research professor for the operative technique course from May four, 2020, to January 17, 2021, at the Faculty of Human Medicine of Ricardo Palma University.

The evaluations of the competencies achieved for the single and cruciate points were:

1. Rubric of the evaluation of technical skill based on the general guidelines OSATS (objective structured assessment of technical skills) [12] modified, validated internationally, and by a judgment of faculty surgery faculty experts. These guidelines are evaluated on a Likert scale from one to five and consist of the following elements: Respect for the tissue, Time and movements, Handling of surgical instruments, Operation flow and planning, and specific knowledge. With a minimum score of 6 and a maximum of 30 points.

2. Rubric of the evaluation of the final product (finished suture), previously validated by a judgment of experts from the faculty and evaluated with a Likert scale from one to five, which consists of the following elements: symmetry of both edges of the wound and the axis of suture, coping of edges, knot, and ends of symmetrical and adequate sizes. With a minimum score of five and a maximum of 25 points.

3. The measurement of operative time: time (in seconds) the student took to perform a stitch.

A review of the registry of the evaluations described for both types of sutures in the ex vivo simulation model was carried out, as well as the recorded videos of the corresponding evaluation session to verify the assigned score. The competency assessment tests were as follows:
-Pre-test: at the beginning of the course
-Second test: at the 6th session
-Post-test: at the 15th session (end of the course).

Procedures

The duration of the operative technique course was the same as for the face-to-face modality of eight weeks (seven theoretical sessions and 15 virtual synchronous practical sessions), and its curriculum was adapted to the virtual modality by the research professor.

All the practices of the operative technique course in the face-to-face modality were carried out in the faculty laboratory, and inanimate fabric simulation models (two sessions) and live experimental animals (rabbits) were used for the different surgical procedures (13 sessions), which had to be adapted to the virtual modality, where the students performed the sutures and surgical procedures on various inanimate simulation and ex-vivo models (chicken).

The construction of the simulation models made at home was conceived and designed by the teacher. The simulation model was shown to the students with the instructions for its preparation through synchronous virtual classes on the Blackboard collaborate platform.
In relation to the surgical suture practices, two simulators were used:

-Cloth table simulator model (flannel) on a hard surface (cardboard, wood, or spiral notebook) of 30 x 22 cm.
-Ex-vivo simulation model (a piece of chicken with skin).

In the first 3 sessions, the students made separate knots and sutures (single stitch, cruciate, horizontal and vertical mattress, Lembert) and continuous (simple suture, cruciate suture, subdermal, drawstring), where the cloths table simulator was used.

From the 4th to the 13th session, the students performed various surgical procedures on the inanimate simulation models (laparotomy, wall closure, appendectomy, drain placement, ostomy, anastomosis, and phlebotomy), where the various surgical sutures were also performed.

In the 14th and 15th sessions: the students made simple and cruciate stitches in an ex vivo model (chicken leg and thigh with skin).

In this new virtual teaching model, the practical sessions were based on the in vivo demonstration of

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each procedure in the respective model, according to conventional surgical technique, synchronously in virtual classes on the Blackboard collaborate platform and also with the help of video tutorials of each pre-recorded surgical procedure performed by the teacher. This video was repeated as many times as necessary for the students to achieve adequate understanding, and then each student performed the procedure. Through telementoring and with the help of the camera, the teacher evaluated and corrected the details of the technique for each student and reinforced it according to their needs during synchronous classes and email (Figure 1).

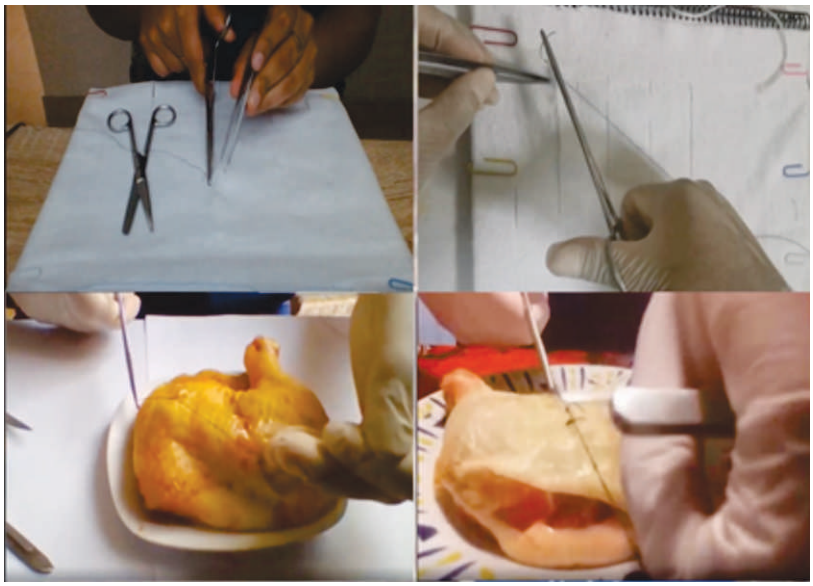

Figure 1. Simulation models for sutures in synchronous classes.

All classes were recorded and automatically uploaded to the virtual classroom of the course. In addition, the theoretical content of each class, video tutorials on sutures, activities, and resources were previously placed before each class in the virtual classroom of the course on the Blackboard Platform.

Statistical analysis

The data were analyzed in the Statistical Package for the Social Sciences (SPSS) version 20. The evaluation data were analyzed with the Wilcoxon test for non-parametric paired variables and the Student's t-test for parametric related samples. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

The data was confidential, protecting the identity of the participants, and ethical principles were respected. No informed consent was given as it is a retrospective evaluation registry study. The Research Ethics Committee approved the research project of the Faculty of Human Medicine of the Ricardo Palma University (Committee Code: PI-001-2021)

RESULTS

This study included 24 students in their fifth year of medical school. The average age was 23 years ± 2.5; 8 men (33.3%) and 16 women (66.7%).

At the beginning of the course, none of the participants knew, nor had they performed any sutures; that is, they did not have skills in performing surgical sutures.

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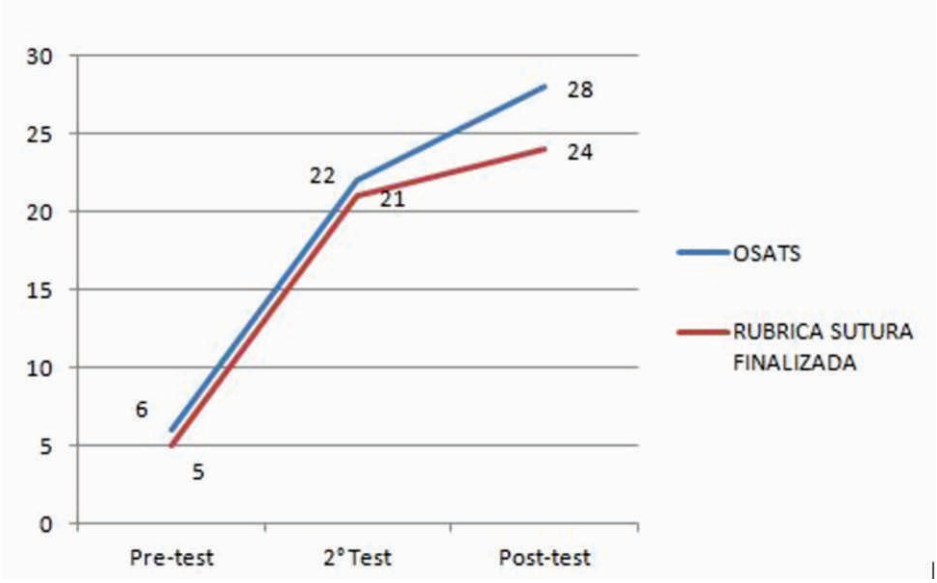
Concerning the simple point: the modified OSATS score in the post-test was 28 ± 2.6, significantly higher than the OSATS of the pre-test's 6 ± 0.28 (p=0.0001).

The finished product rubric score is significantly higher in the post-test, being 24 ± 1.5 compared to 5 ± 0.28 in the pre-test (p=0.001) (Figure 2).



OSATS: Objective Structured Assessment of Technical Skills

Figure 2. OSATS and Single Point Finished Product Rubric assessment scores.

In the pre-test, measuring the time used was impossible because no student could finish the suture. The operative time to perform a simple stitch was significantly longer in the second test with 44 ± 13 seconds than in the post-test with 33 ± 9 seconds (p<0.001) (95% CI 5.9 -14.1). (Figure 3)

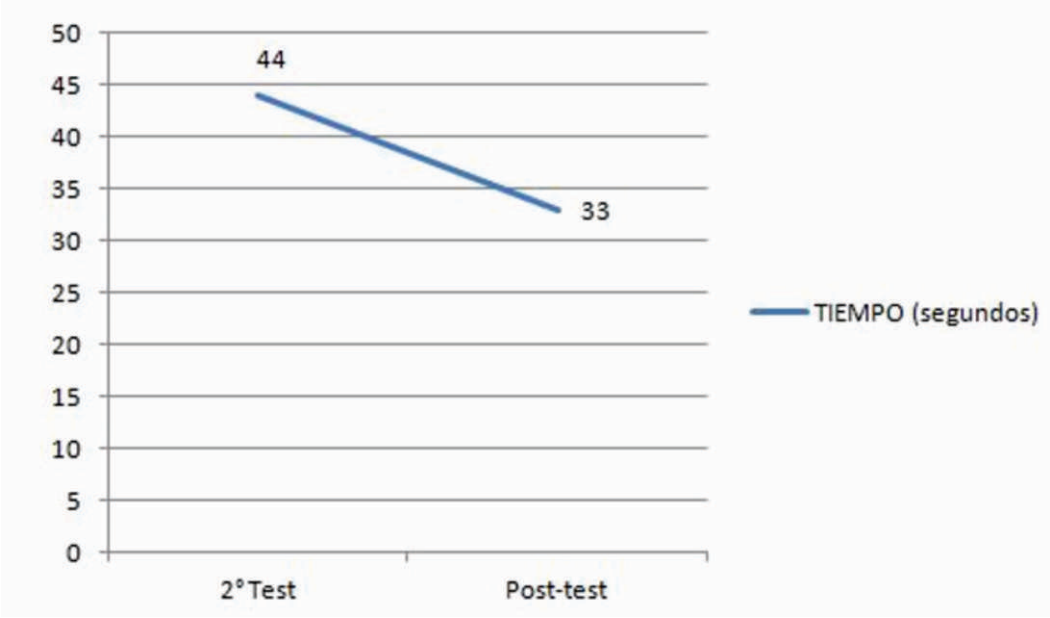
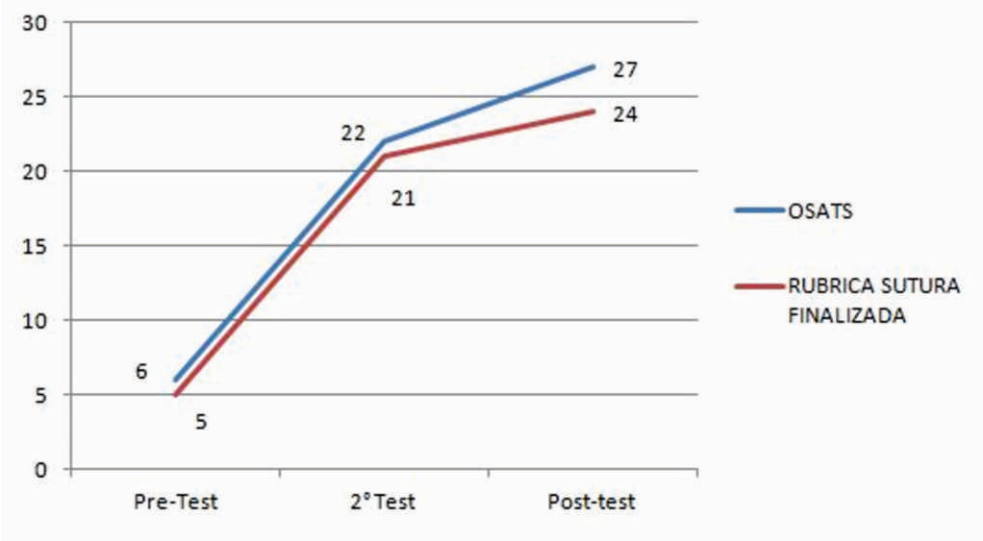


Figure 3. Operative time of the simple stitch according to the OSATS evaluation.

In relation to the cruciate point: the modified OSATS score in the post-test is significantly higher than in the pre-test (27 ± 2.8 versus 6 ± 0.28 (p<0.001).

The rubric score of the finished product was significantly higher in the post-test with 24 ± 1.7 about the pre-test with 5 ± 0.28 (p<0.001) (Figure 4).



OSATS: Objective Structured Assessment of Technical Skills

Figure 4. The score of the OSATS evaluations and the Rubric of the finished product of the cruciate stitch.

). In the pre-test, it was impossible to measure the time used because no student could finish the suture. The operative time in performing a cruciate stitch in the post-test was 52 ± 11 seconds, this being significantly less than the time of the second test of 66 ± 21 seconds (p<0.001) (Figure 5).

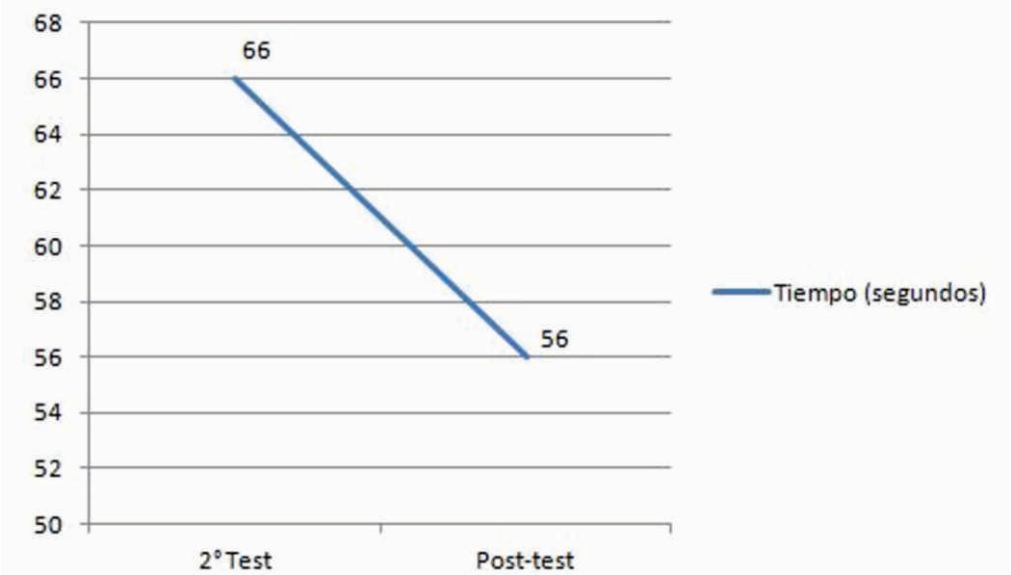


Figure 5. Operative time of the cruciate stitch according to the evaluation test.

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DISCUSSION

Students were able to develop abilities and skills, improving their scores in the evaluations of surgical skills and reducing their time performing sutures. This standardized simulation model is easily reproducible and feasible due to the low cost of materials used and can be used as a teaching-learning tool in sutures in virtual education.

When we compare the results in the simple point with the study by Alvarado J et al. [10] where the practical classes were face-to-face in a simulation model of a high-density synthetic polymer table (rubber-sponge) in medical students of the undergraduate with no knowledge in surgical sutures, who also found a development in the technical skills of the students, we observed that the operative time of a simple stitch was 77 seconds in the post-test, being greater than what was found in our study which was 33 seconds.

In addition, in the aforementioned investigation, they obtained a modified OSATS score in the post-test of 19, which is lower than the OSATS score found in our study of 28 points. This could be explained because our course lasted longer and was not only limited to the teaching of surgical sutures but also of various surgical procedures in simulation models made at home and with it a greater development of the skills and competencies of the students.

Few published studies evaluate the skills acquired in performing sutures in medical students, demonstrating the improvement of their competencies. Still, all were carried out in simulation laboratories of the universities [9,10,13,14]. In contrast, others have evaluated the degree of satisfaction concerning the suture simulation model[8,15] or described a program of methodological alternatives in wound sutures using skin-on chicken pieces as a simulation model [11].

The way in which the different medical schools in the world adapted themselves to practical teaching in virtual surgery was by using virtual platforms such as virtual classrooms, teleconferences, videos of surgeries or procedures, and virtual reality surgical simulators [16-19].

All these tools were used in the course, except virtual reality simulators, which are very expensive and not accessible in our environment. Therefore, it was extremely necessary to create low-cost and easily reproducible stimulators for students at home so that the teacher could teach the surgical procedure in these simulation models through teleconferences and that the students could perform them independently in a synchronous way. In this way, the students could learn and develop new skills, always helped by the teacher's telementoring for the continuous improvement of their surgical technique.

There are reviews of the publications where they refer that, during the pandemic, oncology surgery students and residents used surgical simulation models made at home. Still, they do not specify which ones the students used[16]. There are studies that refer to the use of various homemade simulation models of surgical procedures or laparoscopic surgery for residents [20]; however, very little is said about surgical training in medical students. In addition, in these investigations, few refer to the validity of their simulation model. However, they determine the satisfaction of its use by users and whether they can replicate it at home to improve their skills in laparoscopy or open surgery [16,22,23].

Few studies seek to measure competencies in these easy-to-make simulation models and show a significant improvement in surgical skills. Still, all of them are in simulation laboratories, except for one study where all the training of undergraduate veterinary students for the realization of a simple stitch, was virtual with video tutorials, interactive and inanimate simulation models, where improvements in their skills were found when suturing pig carcasses at the end of their training [23].

One of the limitations of the study is not being able to measure the skills of the students in clinical practice, due to the current situation, and compare them with

the students who took the course in person, which will remain pending in some subsequent.

CONCLUSION

The virtual education model used in the operative technique course for undergraduate medical students showed that training in surgical sutures, such as simple stitch and cruciate stitch, and the evaluation in the development of skills acquired in this surgical technique is possible.

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Correspondence: *Consuelo Elsa Cornejo Carrasco.*
Address: *El Cortijo 473 casa N° 8. Urb. Monterrico Chico, Santiago de Surco.*
Telephone number: *998451040*
E-mail: *docconsuelocornejo@gmail.com*

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