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Mejora de las habilidades de sutura después de entrenamiento. Presentación de un modelo de simulación y de evaluación.

Improvement of suturing skills after training. Presentation of a simulation and evaluation model.

Lorenzo López-Guajardo[1], Sara García-Caride[2], Julia Sánchez Quirós[3], Juan Donate López[4], Rosario Gómez de Liaño Sánchez[5], Julián García-Feijóo[6]

Ophthalmology Department, Hospital Clinico San Carlos, Madrid (Spain).

1, llguajardo@icam.es, ORCID 0000-0002-8573-2555, 2, sara.garcia.caride@gmail.com, ORCID 0000-0002-4048-6119, 3, juliasquiros@gmail.com, ORCID 0000-0003-1580-7360, 4, juan.donate@amqoftalmos.es, ORCID 0000-0002-9944-6736, 5, 1961rgls@gmail.com, ORCID 0000-0001-6952-4521, 6, jgarciafeijoo@hotmail.com. ORCID 0000-0002-7772-5718.

* Correspondencia: sara.garcia.caride@gmail.com

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Resumen: Introducción. Adquirir habilidades quirúrgicas a través de la simulación es una necesidad creciente en la actualidad. Cada día se valora más la seguridad del paciente, y por ello es inaceptable que cirujanos sin la formación adecuada previa atiendan a los pacientes. Nuestro objetivo es desarrollar un sistema de simulación de bajo coste, y una escala de medida, que permita evaluar la adquisición de conocimientos. Métodos. Se eligieron 12 residentes de primer año de oftalmología para realizar dos sesiones grabadas, donde realizaron diferentes técnicas de sutura. Entre ellas, a los residentes se les permitió completar un entrenamiento de 4 sesiones. Después de completar el entrenamiento, las sesiones inicial y final fueron evaluadas por 3 cirujanos expertos. Se utilizó la prueba de Mann-Whitney para comparar puntuaciones. Y se comprobó la concordancia entre los tres evaluadores mediante la prueba de concordancia kappa de Fleiss. Resultados. La concordancia en la evaluación entre los tres examinadores fue sustancial, κ= 0,71 (IC 95%, 0,33 a 0,82), $p < .0005$. Los residentes mejoraron su desempeño promedio después de completar el entrenamiento (6,52 vs 7,81); sin embargo, no se encontraron diferencias significativas debido al pequeño número de participantes. Conclusión. Desarrollamos un sistema de entrenamiento portátil de bajo coste para la adquisición de habilidades quirúrgicas en un grupo de residentes. Asimismo, hemos desarrollado una escala de evaluación que permite evaluar objetivamente la progresión.

Palabras clave: residentes, simulación, quirúrgica, entrenamiento, suturas, oftalmología.

Abstract: Introduction. Acquiring surgical skills through simulation is a growing need nowadays. Every day more, patient safety is valued, and therefore it is unacceptable that surgeons without previous training attend patients. Our objective is to develop a low-cost simulation system, and a score, which allows evaluating the acquisition of knowledge. Methods. 6 first-year ophthalmology residents were chosen to perform two recorded sessions, where they performed different suture techniques. Between them, the residents were allowed to complete a 4-session training. After completing the training, the initial and final sessions were evaluated by 3 blind expert surgeons. Mann–Whitney tests were used to compare scores. And the agreement between the three evaluators was checked using the Fleiss´ kappa concordance test. Results. The concordance in the evaluation between the three examiners was substantial, κ= 0,71 (IC 95%, 0,33 a 0,82), $p < .0005$. Residents improved their median performance scores after completion of training (6,52 vs 7,81) however, no significant differences were found due to the small number of participants.

Conclusion. We developed a low-cost, portable training system with acquisition of skills in a group of residents. We have also developed an evaluation scale that allows to objectively assess progression.

Key words: residents, simulation, surgical, training, suture, ophthalmology

1. Introduction

To become competent surgeons, trainees must acquire skills. The way of acquiring these skills should be progressive and supervised. We should avoid trainees facing patients without the proper training. Coaches should provide the students with the required materials and methods and register their progression objectively as to enable them to treat patients whenever they are deemed capable (1,2).

Although it seems obvious that the more you train the better you will be, we present an objective method for assessing competency level after this kind of training. We have defined our own scale based on the ICO-OSCAR (International Council of Ophthalmology's - Ophthalmology Surgical Competency Assessment Rubric) scale. We have rated and compared the performance of 12 ophthalmology residents before and after practicing suturing in training skin pads. To sum up the objective of this study is developing a low-cost simulation system, and a score, which allows evaluating the acquisition of knowledge.

2. Methods

Figure 1. Example of a resident, training with the silicone suture pad, and ophthalmic surgical instruments.

Participants.

The study was designed as a single-center and prospective. First year ophthalmology residents from Hospital Clínico San Carlos, Madrid were recruited to participate in this study. A brief survey of their experience was conducted, assessing that all of them had the same previous experience suturing. Informed consent was obtained from each resident.

Portable Suture Training Kit

We provided each resident with a portable training kit. The kit included a large silicone suture pad, and a full set of basic surgical instruments, including an ophthalmic needle holder and an ophthalmic toothless tweezer forceps. A carrying bag and practice sutures of 20cm with 5/0 nylon were included (figure 1).

Previous preparation

First, an introductory theorical lesson was lectured to the residents by two different consultant ophthalmologists not involved in the evaluation about the different knots and suturing techniques. Particularly horizontal and vertical mattress suture, subcutaneous suture, single suture, and continuous suture.

Evaluation Method.

Once the theorical part was completed, residents underwent two identical sessions. In each session they should perform the following sutures: horizontal and vertical mattress suture, subcutaneous suture, and continuous suture while they were video recorded (supplementary material). Between the first and second recorded sessions, a four-session training period was developed, identical for the six residents. Each of this training sessions had a duration of 3 hours during the afternoon and the residents performed these sessions in pairs. For this training sessions they used the same material than for the recorded ones.

The videos were sent to three different blind experts. These experts posteriorly evaluated the codified and randomly ordered videos recorded of the pre- and post-training assessments, applying our own scale based on the ICO- OSCAR scale. We considered expert surgeons as those who had done at least 2500 ophthalmology surgeries, to be able to assess and rate the performance of the residents.

In order to ensure standard and robust assessment, the International Council of Ophthalmology (ICO) has created the Ophthalmology Surgical Competency Assessment ICO-OSCAR. It sets clear guidelines for the different levels of skill with which a step is performed (from 'novice' to 'competent'). The steps of the operation are arranged in rows, and the columns correspond to the level of skill achieved (3).

The ICO have developed many OSCARs for different procedures, including extracapsular cataract extraction, phacoemulsification, pediatric cataract surgery, small incision cataract surgery, strabismus, lateral tarsal strip surgery, trabeculectomy, and vitrectomy. The ICO-OSCAR also assesses more general aspects of surgical performance. These are termed the 'global indices". We have selected eight different items from the different OSCARs scales. We have chosen the aspect that most adapt to our study. In this way, most of them are from the strabismus OSCAR scale, but also from the cataract surgery scale.

The scale used valued the following items: vertical and horizontal mattress stitch, simple and continuous suture, subcutaneous suture, velocity and fluidity of movements, needle assembly technique and making knots ability with instruments. All these items were graded from 1 (beginner); 2 (intermediate) and 3 (advance) points (Table 1). Finally, the results were compared and statistically analyzed as follows.

Statistical Analysis

Statistical analysis was done using the Statistical Package for the Social Sciences version 21.0 (SPSS Inc., Chicago, IL). Since the population size was less than 30 to 40 individuals, we cannot assume that the data follow a normal or Gaussian distribution. Therefore, the Kolmogorov–Smirnov test was applied to the data, confirming variables without a normal distribution. Individual final scores were obtained from the average score given in each item of the scale at the initial and final assessments by the three evaluators. Mann–Whitney's test was used for comparing the initial and the results for each item of the scale. The Fleiss' kappa statistical test was used to assess the reliability of

the improvement measured by the three experts. using Fleiss's kappa coefficient (κ) with a 95% confidence interval.

Date _____ Resident ____		BEGINNER (SCORE=1)	INTERMEDIATE (SCORE= 2)	ADVANCE (SCORE=3)
1	**Vertical mattress suture**	**Inadequate** number of points. **Inadequate** tensioning of the points. It **does not achieve** complete closure of the wound.	**Inadequate** number of points. **Adequate** tensioning of the points. **Achieve** wound closure	**Adequate** number of points. **Adequate** tension of the points. **Achieve** wound closure.
2	**Horizontal mattress suture**			
3	**Simple suture**			
4	**Subcutaneous suture**			
5	**Continuous suture**			
6	**Speed and general fluidity of movements**	Constantly insecure, frequently starts and stops, not fluent.	Occasionally starts and stops, manipulations unnecessary and ineffective,	Unnecessary and ineffective manipulations are avoided
7	**Needle mounting technique**	Great difficulty to mount the needle requiring multiple attempts. Needle in wrong position. Damaging the needle	Able to mount and position the needle in the holder but with rotation and instability of the needle.	Needle mounted 2/3 of its length in the holder, firmly held that allows a safe passage no hesitant.
8	**Making knots with instruments**	Great difficulty to tie the knots. Wrong number of turns loops too large. Incorrect technique.	Ability to tie knots by controlling the length of the sutures and the number of turns but without agility.	Great skill and agility to make instrumented knots.

Table 1. Different items and scores of the evaluation as performed with our own ICO-OSCAR scale (International Council of Ophthalmology's - Ophthalmology Surgical Competency Assessment Rubric).

3. Results

A total of 12 postgraduate first year ophthalmology residents were included. The median age was 25,3 years (range: 24–29 years). There were no differences in baseline time performance.

Evaluation of Videos and Interrater Reliability

A total of 24 videos were analyzed by 3 experts. The experts rated the videos in separate rooms so they could not influence the decision of the others. The interrater reliability was calculated based on the improvement valued for each resident. The improvement was rated by the difference between the total evaluation of the first video and the second one. The level of improvement was then classified in worsening (final score <0); mild improvement (final score 0-3.5) and great improvement (final score 3,5- 7).

Fleiss' kappa showed that there was substantial agreement between the experts, κ= 0,71 (IC 95%, 0,33 a 0,82), p < .0005. Kappa values of 0.00 to 0.20 were considered slight agreement, 0.21 to 0.40 fair agreement, 0.41 to 0.60 moderate agreement, 0.61 to 0.80 substantial agreement, and 0.81 to 1.00 almost perfect (4).

Pre–Post Training Performance Improvement

The group significantly improved their scale scores comparing the initial and final assessments: pretraining scores 6,52; 35,5 were lower than those of the post-training 7,81; 42,5 U= 15,7, p= 0,55. For each item of the scales the results were as follow (Table 2).

	TRAINING PHASE 0 = PRE; 1 = POST	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Exact Sig.
Vertical mattress suture	0	12	**6,20**	35,50	16,5	0,589
	1	12	**7,01**	42,50		
Horizontal mattress suture	0	12	**6,32**	38,50	14,5	0,836
	1		**6,78**	39,50		
Simple Suture	0	12	**5,07**	31,00	11	0,340
	1	12	**7,93**	47,00		
Subcutaneous suture	0	12	**5,45**	38,00	16,5	0,770
	1	12	**6,64**	40,00		
Continuous suture	0	12	**6,51**	39,50	18	0,837
	1	12	**7,42**	38,50		
Speed and fluidity	0	12	**5,92**	29,50	8	0,062
	1	12	**7,08**	48,50		
Needle mounting technique	0	12	**6,23**	38,00	16	0,635
	1	12	**6,70**	40,00		
Making knots with instruments	0	12	**4,90**	33,00	13	0,194
	1	12	**6,50**	45,00		

Table 2. Comparison of pre- and post-training scores.

4. Discussion

The use of simulators to learn a certain surgical technique is an increasingly common practice. Nowadays, the trend is towards an increased demand for patient safety which has led to lower participation of residents in some surgical settings. And this makes impossible to create expert professionals for the future. SARS-CoV2 pandemic has also led to a cessation of surgical activity with the consequent decrease in surgical manual skills (5). Simulation solves a large part of these problems, since it allows better control of the situation (5). In many surgical specialties, the learning curve has been evaluated with different simulators (7,8).

In this study we propose an assessment scale and a low-cost and portable microsurgery kit. We have chosen first-year residents, to ensure that they had no prior training. And we have shown an improvement in the assessment of the scale after training. We are aware that the sample is small, and therefore our comparisons did not obtain significant results. After reviewing other simulators described in the literature, our proposal is a cheaper and simpler alternative (9,10).

In summary, we have created a cheap, portable, wireless simulation system and a skill measurement scale validated in a group of 12 residents. This method resulted in skill improvement when comparing the evaluation of their results by three experts. Moreover, the concordance was classified as substantial agreement with a Fleiss' kappa value of 0,71 (4). We believe that our model has a wide practical application, as well as economic advantages making it a great learning tool.

5. Conclusions

- A cheap, portable, wireless simulation system and a skill measurement scale were created and validated in a group of 12 residents.

- Suture skills were improved as assessed by a group of experts.
- This method has a great practical application as well as economic advantages.

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Referencias

1. Shah NP, Lalli A, Palmer J, Jones J. Objective assessment of intra-oral suturing for certification of competency. Eur J Dent Educ. 2021;10.1111/eje.12738. https://doi.org/10.1111/eje.12738
2. Kilkenny JJ, White K, Singh A. Evaluating veterinary student skill acquisition on a laparoscopic suturing exercise after simulation training. Vet Surg. 2019;48(S1): O66-O73. https://doi.org/10.1111/vsu.12930
3. ICO. Surgical Assessment Tool: ICO-OSCAR in English, Mandarin Chinese, Portuguese, Russian, Spanish, Thai, Vietnamese, and French 2018. https://icoph.org/education/ophthalmic-educators/
4. Kappa Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977; 33:159–74.
5. Theodoraki K, Naderi K, Lam CFJ, Tan JK, Jameel A, Lai L, Garcia LO, Low S, Bhogal M, Robbie S, O'Brart D. Impact of cessation of regular cataract surgery during the COVID pandemic on the rates of posterior capsular rupture and post-operative cystoid macular oedema. Eye (Lond). 2022 Feb 3:1–6. https://doi.org/10.1038/s41433-022-01958-y
6. Tellez J, Abdelfattah K, Farr D. In-person versus virtual suturing and knot-tying curricula: Skills training during the COVID-19 era. Surgery. 2021 Dec;170(6):1665-1669. https://doi.org/10.1016/j.surg.2021.06.015
7. Rosen JM, Long SA, McGrath DM, Greer SE. Simulation in plastic surgery training and education: the path forward. Plast Reconstr Surg 2009;123(02):729–738. https://doi.org/10.1097/prs.0b013e3181958ec4
8. Al-Bustani S, Halvorson EG. Status of microsurgical simulation training in plastic surgery: a survey of United States program directors. Ann Plast Surg 2016;76(06):713–716. https://doi.org/10.1097/sap.0000000000000636
9. Masud D, Haram N, Moustaki M, Chow W, Saour S, Mohanna PN. Microsurgery simulation training system and set up: an essential system to complement every training programme. J Plast Reconstr Aesthet Surg 2017;70(07):893–900. https://doi.org/10.1016/j.bjps.2017.03.009
10. Loh CYY, Tiong VTY, Loh AYH, Athanassopoulos T. Microsurgery training–a home do-it-yourself model. Microsurgery 2014;34 (05):417–418. https://doi.org/10.1002/micr.22242