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ORIGINAL ARTICLE

Using mindfulness therapy in laparoscopic simulation training: a pilot study

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Abstract

Objective: Medical students and surgeons are living lives full of stress, which leads them to be in an accelerated state that can result in mistakes and frustration. Our constant desire to be better means that we can forget to be in the present. Mindfulness has been emerging as a new therapy that has been fruitful in different areas. The objective of this study is to explore whether mindfulness therapy could improve laparoscopic training in medical students. **Design:** A pilot study was performed with 10 first-year medical student volunteers. The students were randomly assigned to a control group or the mindfulness group. The control group received no intervention at all. The mindfulness group received mindfulness sessions for 15–20 min free of charge before the laparoscopic training. Five modified tests in laparoscopic simulation were included. The time for two pre-tests and three tests was measured after an assigned training time. **Setting:** The study was performed at the Center for Surgical Skills Training at the University of Chile, Santiago. **Participants:** The study included 10 first-year medical student volunteers from Universidad de Los Andes (50% male and 50% female). We chose to conduct the study with first-year students because they had not had any previous experience in surgery or laparoscopy. **Results:** All 10 participants finished the trial. There were no significant differences in the times for the pre-tests between the two groups. The best improvement between the pre-tests and tests was achieved by the mindfulness group for the colour matching task with an improvement of 72 $\pm$ 1.1 s. The mindfulness group showed a better performance in all final tests compared with the control group, which was statistically significant ($P < 0.05$). **Conclusion:** In this study, the test times for the group who were exposed to mindfulness therapy were improved (reduced) compared with those of the control group. The development and implementation of mindfulness laparoscopic simulation training may be feasible. Further studies are justified to confirm that hypothesis.

Keywords: *mindfulness therapy; laparoscopic training; surgical simulation training; surgical skills*

Introduction

Being a doctor is not an easy task: stress, burnout and frustration among physicians affects mental health, performance and patient outcomes.[1–3] From the early years of medical school, student welfare is threatened by the prominent force of burnout.[4] This is a continuing force that will follow medical students during their careers, through residency and beyond. To lessen this threat, interventions focusing on generating wellness during medical training are highly recommended.[5,6]

An effective wellness curriculum could be put into place to educate residents, encouraging optimism, mindfulness and social connectedness to become standard.[7]

Surgery practice during residency programmes is a high-risk time for burnout.[8,9] Mindfulness training has been shown to increase resilience during surgery residency,[10,11] and this is particularly beneficial to those who report high levels of stress and burnout.

Health care professional training is linked to providing better quality of patient care.[12] Simulation-based training has been proven to be effective in improving clinical practice because it provides a safe controlled environment for practice, repetition and feedback to reach competency.[13,14]

Future endeavours need to provide surgeons with skills to help them respond effectively to their environment and prevent them burning out.[15]

Mindfulness is defined as the practice of living in the moment. It arose in Kapilavastu, on the current border between Nepal and India, about 2500 years ago at the hand of Siddharta Gautama, the man who became the Buddha, or the Enlightened One.[16] The founder of mindfulness as a scientific discipline was Dr Jon Kabat-Zinn, who at the end of the 1970s founded the Stress Reduction Clinic at the Medical Center of the University of Massachusetts, one of the most important in the world.[17]

Since then, its application as a technique to improve the quality of life of healthy individuals has grown exponentially.[18] The medical field is no exception.[19] Reports describe a decrease in burnout symptoms and increased work engagement and well-being,[20] and a better work environment,[21] with the use of mindfulness training. There is even evidence that improving clinician mindfulness can also improve patient health outcomes.[22]

The beneficial effect of mindful practice among surgical trainees has been reported.[23] Residents' achievement of core competencies, which currently may be challenging for surgical educators, may be facilitated by higher levels of mindfulness.[24]

Mindfulness has been perceived to contribute positively to self-assessments of competency, performance and productivity.[25] This is explained by the increased insular cortex activity associated with changes in functioning of the insula, which might have an impact on one's awareness of internal reactions in the moment.[26]

Continued integration of the concept and process of mindfulness in simulations is planned to enhance not only patient outcomes but student outcomes as well.[27] External environment miscue leading to an error can be eliminated by application of these practices in simulation of safety procedures.[28]

Mindfulness training is now also included in curricula in undergraduate medical schools.[29] Introducing mindfulness in the academic field of medicine could result in a number of positive outcomes.[30,31] Although the evidence points towards the usefulness of teaching mindful practices, many unanswered questions remain.[32]

Employers and regulatory bodies should be accountable for workforce/trainees' well-being and be held accountable for promoting a culture in which trainees can learn in more sustainable settings throughout their careers, with reduced stress.[33]

Practicing mindfulness meditation may enhance both the well-being of individuals and team function under high-stress conditions.[34] It is essential to equip residents of the future and practicing physicians with appropriate training tools to promote mindfulness and emotional intelligence throughout their education and professional life to improve well-being.[35]

No studies have examined the effect of mindfulness therapy on surgical simulation training. Therefore, the purpose of this pilot study was to explore the relationship between mindfulness therapy and better laparoscopic training outcomes in medical students.

Materials and methods

This randomized controlled pilot study was conducted in Chile as part of a project during the elective internship at the Universidad de Los Andes, in June 2018. The study was performed at the Center for Surgical Skills Training at the University of Chile, Santiago. This study was approved by the ethical scientific committee of the research department of the University of the Andes. The trial took place in one session on Saturday, June 9, 2018.

An email was sent to first-year medical students with the invitation to participate in the study. The study included 10 first-year medical student volunteers from Universidad de Los Andes (50% male and 50% female). First-year students were selected for this study, because they did not have previous experience in surgery or laparoscopy. All volunteers completed a demographic questionnaire and provided informed consent authorizing the disclosure of information for the study. The demographic questionnaire collected data on age, gender and dominant hand.

Within the inclusion criteria, first-year medical students more than 18 years old who began their studies in 2018 and wanted to participate voluntarily in the study by signing the informed consent were considered. In addition, only right-handed volunteers were included.

The exclusion criteria were having participated in some surgery as an observer or in a practical workshop of surgical skills, not wishing to participate in the study, leaving without completing the trial, having studied another career besides medicine, or suffering from colour blindness or deafness.

The students were randomly separated into two groups by choosing a paper marked with the group from inside a box. Five students were assigned to the mindfulness group and the remainder to the control group. Information about the intervention was unknown by the participants until the end of the study.

Five T&C (Training & Competence, USA) LS-910 laparoscopic simulators were used in the study (Fig. 1.) Five modified tasks were selected from popular curricula such as the Southwestern Stations and Fundamentals of Laparoscopic Surgery.[36]

The team at the Surgical Skills Training Center (coordinator, residents, fellows and elective interns) were the evaluators during the study. When the measurements were taken, the evaluators did not know to which group each student belonged. Variables analysed included the time taken to perform the laparoscopic training.

The time taken for each task was measured twice before the training as pre-tests. After the training, the times of three final tests were measured (Fig. 2). Time was stopped and recorded when the student completed the task correctly.

Before each task, the mindfulness group were given between 15 and 20 min of free online access to videos of guided mindfulness therapy sessions.[37–41] A room inside the centre was specially set up for the mindfulness group. Headphones were given to each member, and an email with the mindfulness therapy videos was sent to them. They were asked to keep their cell phones in "do not disturb" mode during the sessions. One examiner ensured that the sessions were completed correctly.

Figure 1. T&C LS-910 laparoscopic simulator.

Each group member was assigned a simulator and corresponding laparoscopic material. At the beginning of the tasks, an examiner showed the members of the group how to do the exercise. Questions that arose were answered. Subsequently each member went to their simulator to start the pre-tests. Each group performed the two pre-tests for the first task, followed by 15 min of free training, and then the three tests were applied, measuring performance by the time taken to complete the tests correctly. The two groups used the simulation room alternately until all five tasks had been completed by both groups. There was no interaction between the groups during the changeover.

First task: running string

A 120-cm-long rope, marked every 10 cm, is wound inside a designated area (modified from Scott et al.[42]). The rope is traced from one end to the other by gripping on the designated markings (Fig. 3). The monitor records if the grip is not correct and the whole task must be repeated. The test is scored only by the time taken to complete the task correctly.

Second task: block move

Four blocks have to be transferred from their base to a designated area using a grasper and a curved needle. During the transfer, the needle must go through a small ring on the top of the block to take it to the location marked on the right (Fig. 4). The blocks must be correctly positioned, otherwise they must be repositioned. The test is scored by the time taken to complete the test correctly.[42,43]

Third task: colour matching

This is a modified task based on the checkerboard task,[42] consisting of arranging 16 plastic coloured crosses in the appropriate squares on a flat surface (Fig. 5).

Fourth task: peg transfer

For the peg transfer test, there is a table with 12 sticks in the centre of the screen. On one side of the table are six rings over six sticks.[43,44] Each of the six objects must be raised with the non-dominant hand and placed on the other side

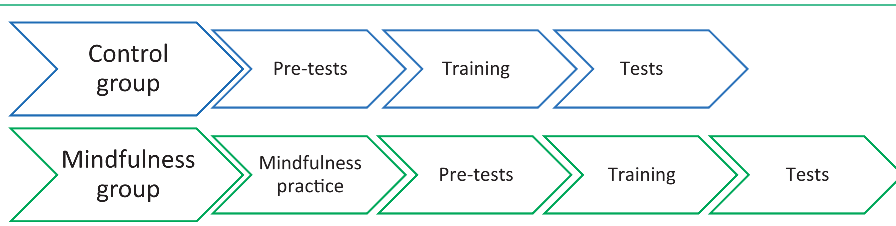

Figure 2. Testing and training protocol for the two study groups for each of the tasks.

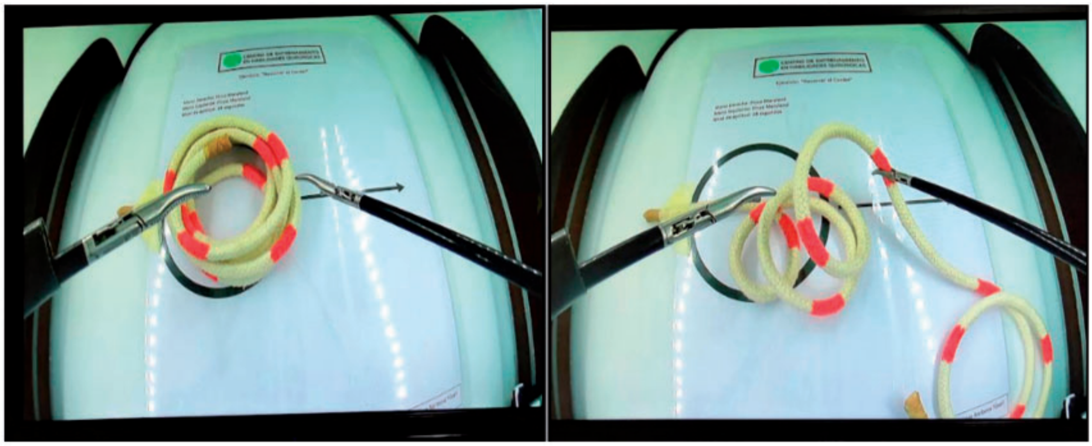

Figure 3. Running string task.

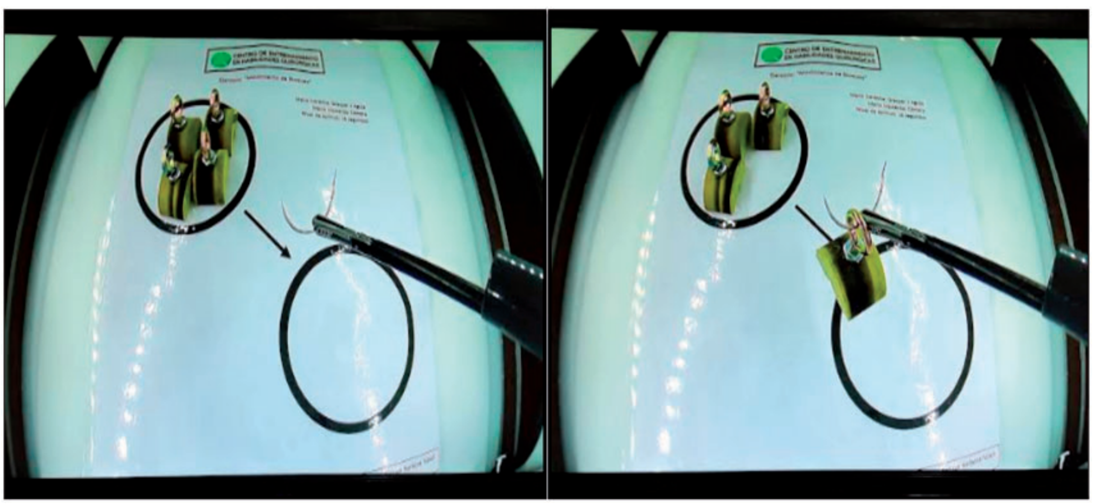

Figure 4. Block move task.

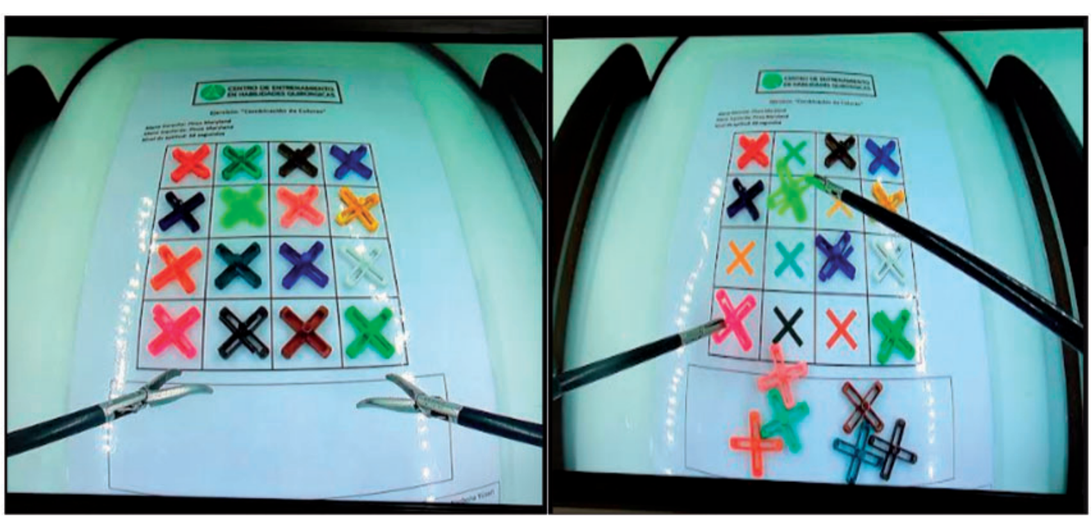

Figure 5. Colour matching task (modified checkerboard task).

after passing to the dominant hand (Fig. 6). Because of time limitations, we modified the test by not requiring the objects to be returned to the initial position. The exercise began when the dissectors appeared on the screen and ended with the placement of the last ring. If a ring fell, it had to be picked up with the same dissector from which it fell.

Fifth task: bean drop

In the bean drop task, five beans are grasped individually and moved 15 cm to be placed in a 1-cm hole at the top of an elevated cup. The dominant hand is used to grasp the beans and the non-dominant hand moves the laparoscope to provide adequate visualization during the procedure.[42] We reduced the number of beans to three to reduce the time needed for this test.

Each group had its own sheet to record the times of the evaluations. The measurements for all the tests were recorded by the examiners and then tabulated on a computer.

Results were analysed with the Student unpaired t test, and a P value of 0.05 was considered statistically significant. Statistical analysis was performed with the IBM Statistical Package for the Social Sciences (SPSS) Statistics software version 25.

Results

All participants in both groups (100%) completed the five tasks successfully. All were right-handed, and the trainee mean age was 18 ± 0.8 years. It took 6 h to complete the trial.

The mindfulness group (5 volunteers) consisted of 3 men and 2 women. The mean age was 19 years; the control group consisted of 3 women and 2 men with a mean age of 18 ± 0.6 years (Table 1). The average time spent by the mindfulness group viewing videos was 17 ± 0.47 min and the training time between the pre-tests and the tests was 15 min.

The results of the pre-tests were tabulated in the computer and the average times obtained by both groups were used for the statistical analysis (Table 2). The control group had

Table 1. Demographic data[a]

	Mindfulness group (n = 5)	Control group (n = 5)
Age (years), mean ± SD	19 ± 0.0	18 ± 0.6
Percentage of females	60	40
Percentage right-handed	100	100

[a] P value not significant for all comparisons.

Table 2. Time measurements for the pre-tests of both groups

Task	Group	N	Mean time (s)	Standard deviation (s)
Running string pre-test	Control	5	88.900	25.4568
	Mindfulness	5	96.800	12.9451
Block move pre-test	Control	5	79.500	34.0165
	Mindfulness	5	63.900	7.4783
Colour matching pre-test	Control	5	138.600	22.5981
	Mindfulness	5	126.600	20.1631
Peg transfer pre-test	Control	5	121.300	50.1717
	Mindfulness	5	108.000	32.3805
Bean drop pre-test	Control	5	47.000	23.1409
	Mindfulness	5	70.000	18.9044

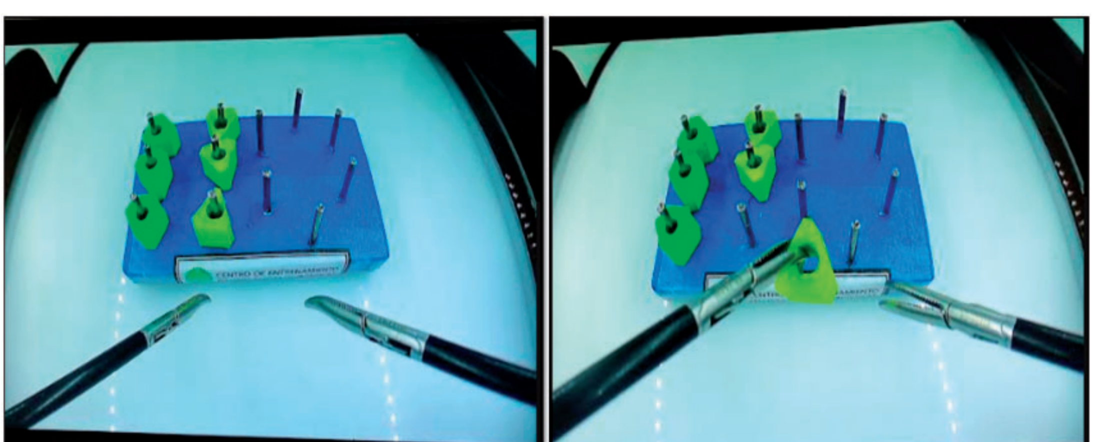

Figure 6. Peg transfer task.

better times on the pre-test for the running string and bean drop tasks, and the mindfulness group outperformed the control group in the other tests. There were no statistically significant differences between the two groups in their pre-test results (Fig. 8).

The same procedure was used for the final tests, and the average of the three completed task time measurements was used for the analysis (Table 3). These results showed a clear difference between the groups in all tasks, with better performance from the mindfulness group (Fig. 9). The variables were analysed to see the difference between them and the results were statistically significant.

The greatest improvement between the tests and the pre-tests was achieved by the mindfulness group for the colour matching task with an improvement of 72 ± 1.1 s. Both groups took less time to complete the block move task with an average time of 24 ± 1.2 s between the two groups.

Due to the size of the sample (n = 10), the Shapiro–Wilk normality test was used for all tasks, showing that all variables were normally distributed. Finally, the results were tested by the Student unpaired samples t test.

There was a clear improvement in the tests compared with the pre-tests in both groups. Although both groups improved the performance time on the final tests, this dif-

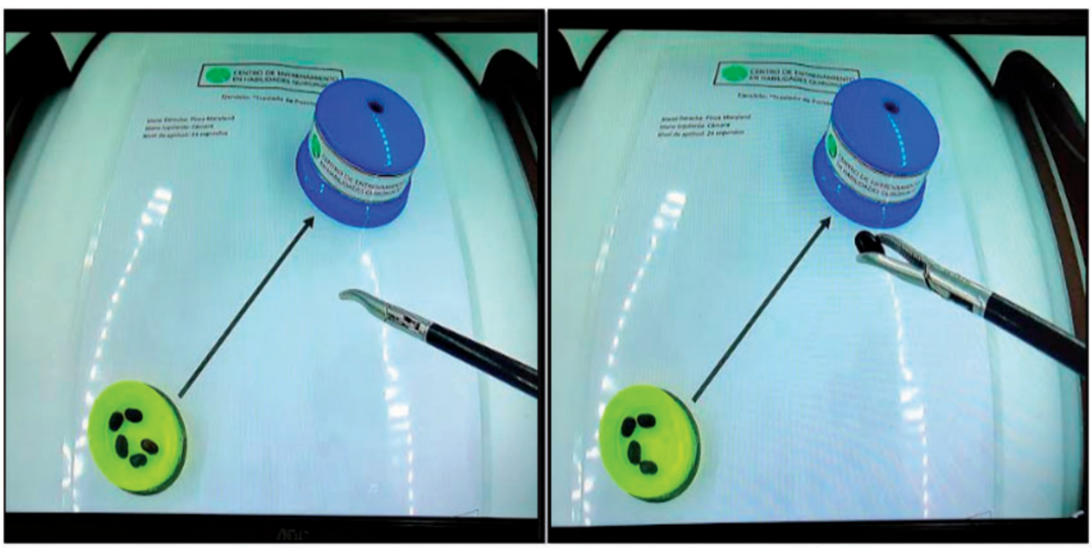

Figure 7. Bean drop task.

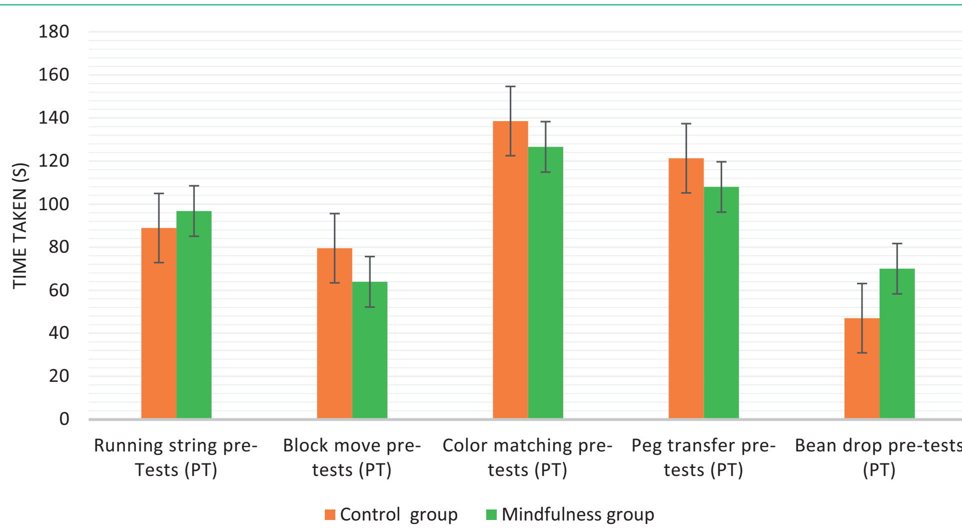

Figure 8. Mindfulness group versus control group pre-tests times.

ference was not statistically significant. It was observed, although somewhat subjectively, that the mindfulness group appeared to perform better in both timing and accuracy after the training.

When the times to perform the final tests were compared between the two groups, the analysis showed all parameters were significantly different between the mindfulness and the control groups (Table 4).

Discussion

Based on the results, it is possible to suggest that mindfulness therapy is related to better laparoscopic training outcomes in the simulation of laparoscopic surgery.

In a comparative study of simulators for laparoscopic surgery, Romero et al.[45] highlight the importance of having study populations without any previous surgical experience to avoid the results being affected by the experience of trained surgeons or by surgical skills previously acquired.[46] The inclusion and exclusion criteria of this study were designed with this in mind.

Table 3. Time measurements for the tests of both groups

Tasks	Group	N	Mean time (s)	Standard deviation (s)
Running string test	Control	5	47.220	8.5864
	Mindfulness	5	31.740	2.7898
Block move test	Control	5	28.500	2.4485
	Mindfulness	5	20.920	2.1371
Colour matching test	Control	5	69.140	9.7976
	Mindfulness	5	53.940	3.4443
Peg transfer test	Control	5	69.740	6.5641
	Mindfulness	5	48.140	9.3404
Bean drop test	Control	5	46.520	6.0131
	Mindfulness	5	29.360	5.7287

For the purposes of this study, no association studies were made between the times obtained (pre-test and test) and demographic variables such as sex and age. Future investigations could investigate if there are correlations.

There was a lack of statistically significant differences in the pre-test times between the groups and the appearance of statistically significant differences in post-training times (test) for each of the five tasks. The reason could be in what was described by Fadel et al.[47] who observed that the application of brief mindfulness training reduced participants' fatigue and anxiety ratings. This effect has also been studied in the medical field.[48] All the conditions described above have been linked to a lower level of accuracy, decision making and mathematical skills in some populations.[49]

The maintenance of a state of alertness and precision, added to the improvements in performance and productivity during the training period,[25] could explain the better results for the mindfulness group; however, further studies are necessary to verify this hypothesis in addition to checking the maintenance of these tendencies with longer training times or increased difficulty of the exercises.

The limitations of this study are related to the use of free online access to videos of guided mindfulness therapy sessions. Some studies support them as an alternative to achieve the goals of mindfulness,[50] but most of the evidence supporting this practice is based on guided interventions. Other limitations refer to the difficulty of calculating the

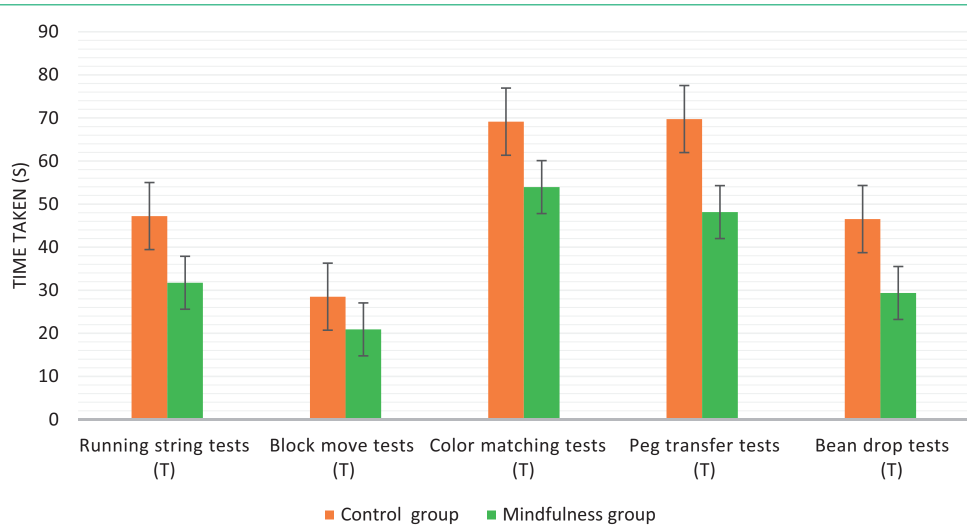

Figure 9. Mindfulness group versus control group tests times.

Table 4. Comparison between the groups using the Student unpaired samples t test

Tasks	t[a]	df	Significance (2-tailed) P value[b]	Mean difference	Standard error difference
Running string test	3.843	8	0.005	15.4800	4.0376
Block move test	5.215	8	0.001	7.5800	1.4534
Colour matching test	3.273	8	0.011	15.2000	4.6445
Peg transfer test	4.231	8	0.003	21.6000	5.1055
Bean drop test	4.620	8	0.002	17.1600	3.7421

[a]Levene's test for equality of variances was applied.
[b]$P < 0.05$ was considered significant with a 95% confidence interval.

necessary sample size and the power of our study, because there was no literature comparing laparoscopic simulation with the practice of mindfulness until now.

Conclusions

This pilot study demonstrated the educational potential of mindfulness therapy, which, in view of the persistent problem of burnout, may be an option in the development of a new educational programme that improves the quality of life for trainees who perform training in laparoscopic simulators. This therapy can be considered a great option to make a significant improvement in high-quality surgical care. We would like to see mindfulness therapy included in surgical training, because it may contribute to an improvement in the quality of life for future surgeons, doctors, residents and students. It is our duty as doctors to improve patient care and improve the quality of medical education. Further studies are warranted to confirm whether inclusion of mindfulness practice during laparoscopic simulation training would be feasible and beneficial.

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Conflict of interest

None declared.

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