



Implementing mindfulness meditation in hand surgery training: a feasibility study

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Abstract

Background Surgery can be stressful, requiring decision-making and performance under pressure. The COVID-19 pandemic has further challenged surgeons' well-being and training. Excess stress adversely affects well-being, technical and non-technical performance, and, by extension, patient care. Little emphasis has been placed on interventions to improve individual surgeons' stress resilience despite mindfulness training being robustly linked to resilience, well-being, and improved executive function and performance. This feasibility study aimed to evaluate the effect and acceptability of a mindfulness meditation session on a group of surgical trainees during a hand fracture fixation course.

Methods All participants of a single-day hand fracture fixation course were invited to take part in the study, and randomised into two groups. The intervention group experienced a 10-min guided meditation session before their assessment, while the control group did not. Basic demographics, inherent 'trait' mindfulness, change in mood, and perceived acceptability were compared between the two groups.

Results The 17 participants were demographically similar, as were their self-reported mood scores until after the meditation, where they diverged significantly ($p < .01$, t -test), with the meditation group feeling more relaxed and calm. Meditation as an intervention was considered largely acceptable.

Conclusions Mindfulness meditation is established in improving stress resilience, relevant to surgeon well-being, performance, and patient care. This feasibility study suggests benefit and acceptability, and potential for further research in designing a targeted programme for surgeons, to reduce stress sensitivity, and improve performance, joy, and well-being within surgical training.

Level of evidence: Level III, Therapeutic study.

Keywords Mindfulness · COVID-19 · Meditation · Training · Hand surgery

Introduction

Being a surgeon entails exposure to stressors. The COVID-19 pandemic has created further challenges to well-being and training in surgical practice [1, 2]. The perception of excess stress adversely affects well-being, technical, and non-technical performance and, by extension, patient care. Immediate effects on performance are mediated by preoccupation with outcome, distraction, and the inability to focus [1]. Chronic stress exposure can impact physical and mental health and lead to experiential avoidance, compassion

fatigue, and burnout [1]. Thus far, workplace environment and work-life balance have been the main targets of stress relief and mental health initiatives [3]. Little emphasis has been placed on interventions to improve individual surgeons' resilience in surgery.

Mindfulness describes a state of being attentive to and aware of what is taking place in the present moment, without judgement [4]. Mindfulness practice has been robustly linked to resilience, well-being, and improved executive function and performance [5, 6]. While individuals differ in inherent, or 'trait' [4], mindfulness, it can also be nurtured and cultivated. Mindfulness training is frequently employed in the military, law enforcement, and elite sport [6–10], but is not well established in surgical training in spite of its known benefits. Mindfulness meditation is one of the most commonly employed and accessible techniques to increase mindfulness.

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This feasibility study aimed to evaluate the effect of a mindfulness meditation session on a group of surgical trainees during a hand fracture fixation course, and to explore how acceptable the intervention was to them. Its outcomes were to quantify their trait mindfulness, observe the changes in their mood throughout the course, assess their situational awareness, and explore the acceptability of mindfulness meditation for this group.

Materials and methods

Appropriate clinical governance was sought. All participants of a routinely running, nationally recruited, single-day hand fracture fixation course were invited to take part in the study. Written consent was obtained and the option to withdraw at any time emphasised. The participants were assigned study numbers for anonymity and randomised into two groups (randomlists.com). Both groups watched an initial lecture component, group 1 (control) in person and group 2 (intervention) from home. Group 1 performed the practical part of the course on 3D printed hands (Stelth Ltd) [11] and then performed an assessed component of K wiring a 5th metacarpal neck fracture. Group 2 then attended for the practical as above, but with a 10-min meditation (Headspace®, California, with permission) immediately before the assessment. Surveys (Google Forms®) were sent remotely by LC at four different time points (Fig. 1) via independent WhatsApp® groups.

Survey 1 assessed basic demographics and the participants' trait mindfulness using the Mindful Attention Awareness Scale (MAAS) score [4] (Table 1). Self-reported mood measures (Table 2) [5] were assessed at all 4 points in Fig. 1, to evaluate the effect of the intervention on mood compared to the control group. Prospective and retrospective assessment of the acceptability of meditation as a practice was based on the following recommended acceptability constructs [12]: affective attitude, burden, perceived effectiveness, ethicality, intervention coherence,

opportunity costs, and self-efficacy. To assess situational awareness in both groups, a blue sticker was attached to the K wire box, which was present during the first 10 min of the assessment before the box was removed. Awareness of the sticker presence and colour were assessed in Survey 4, when feedback was also sought on the course and simulation material in general.

GraphPad Prism® was used to compare the control and intervention groups using an unpaired, two-tailed *t* test for continuous data, and X^2 test for categorical data, with $p < 0.05$ considered statistically significant.

Results

Seventeen participants were randomised into two groups who were demographically similar for gender, age, meditation practice, and MAAS score (Table 3). The intervention group contained more senior trainees, who had previously performed more K wire fixations of 5th metacarpal neck fractures, but these differences were not significant (Table 3).

The self-reported mood scores at the four time points are shown in Fig. 2. Before and after the lectures (Surveys 1 and 2), there was no significant difference between groups 1 and 2, whereas, after the meditation intervention, the groups diverged significantly ($p < 0.01$). A higher mood score trends towards a less positive state, e.g. anxiety, pessimism, and insecurity (Table 2).

Some of the surveys were discounted for Fig. 2 and Table 4, as they came through as duplicates, or did not arrive and were therefore repeated retrospectively. Since the mood score is designed to be contemporaneous, any mood score surveys submitted > 3 h after the rest, or once a different part of the course had been started, were excluded. The numbers of timely responses of the 8 control and 9 intervention participants included at each point in Fig. 2 were (control/intervention) 8/9 (Survey 1), 5/7 (Survey 2), 4/9 (Survey 3), and 5/5 (Survey 4).

Fig. 1 The time points in the study, when electronic surveys were sent to groups 1 and 2

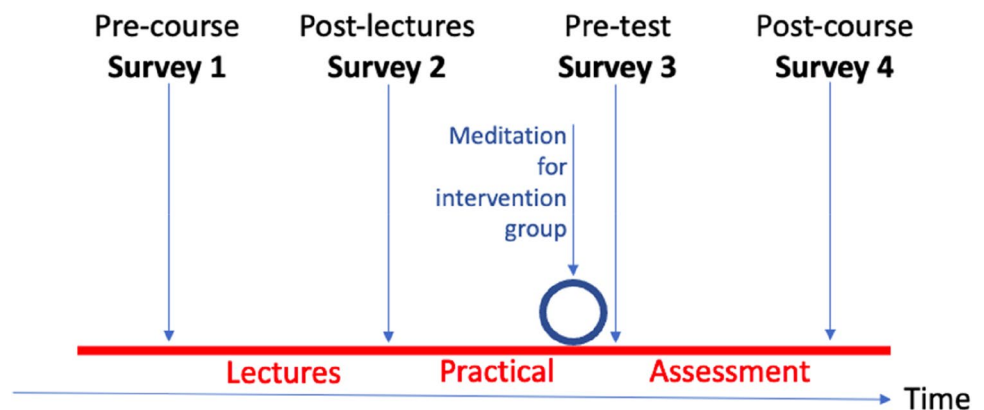


Table 1 The Mindful Attention Awareness Scale (MAAS) score for trait mindfulness [10]

Please rate your ability to pay attention to the present moment and to maintain awareness of whatever is experienced in the present moment from 1 (almost always) to 6 (almost never) for the following statements:

- I could be experiencing some emotion and not be conscious of it until some time later
- I break or spill things because of carelessness, not paying attention, or thinking of something else
- I find it difficult to stay focussed on what's happening in the present
- I tend to walk quickly to get where I'm going without paying attention to what I experience along the way
- I tend not to notice feelings of physical tension or discomfort until they really grab my attention
- I forget the person's name almost as soon as I've been told it for the first time
- It seems I am 'running on automatic' without much awareness of what I'm doing
- I rush through activities without being really attentive to them
- I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there
- I do jobs or tasks automatically, without being aware of what I'm doing
- I find myself listening to someone with one ear, doing something else at the same time
- I drive places on 'automatic pilot' and then wonder why I went there
- I find myself pre-occupied with the future or the past
- I find myself doing things without paying attention
- I snack without being aware that I am eating

On further analysis of Survey 3, there was significant divergence in the calm-nervous ($p=0.02$) and relaxed-anxious ($p=0.04$) domains (Table 4).

Of the 14 who answered Survey 4, 57% (4/7) of the control group and 14% (1/7) of the meditation group correctly identified the blue sticker on the K wire box.

Before the intervention, there was a similar opinion regarding meditation in surgical training, but post intervention, there was a trend for more acceptability of meditation in the intervention group (Fig. 3), significantly with regard to its efficacy in improving surgical training/performance ($p=0.03$) and meditation fitting with the participant's value system/ethical stance ($p=0.02$).

Of the 14 who answered Survey 4, 79% would prefer to meditate alone, 36% in a regular group, 21% in the morning, 14% at lunchtime, 14% in the evening, and 29% whenever (flexible). A total of 36% would like to meditate daily, 14% weekly; 14% would like a face-to-face meditation class and 14% remote; 29% would like a safe place at work to meditate, and 21% would prefer to meditate away from work.

Further free text comments relating to meditation were the following: "I regularly meditate already and find it very helpful. I feel it should become part of daily life and surgical practice." "I swim for meditation, but actually it did work today to have a break in that way."

In general, the course was well-received, with the average quality of lectures 4.9/5, quality of simulation material 4.3/5, and overall course rating 4.8/5 across both groups ($p=0.3$).

Discussion

Surgery can be stressful, requiring decision-making and performance under pressure [13]. As described by Yerkes and Dodson [14], after an initial boost to performance, 'excess' stress, experienced according to an individual's stress sensitivity, has a negative impact on dexterity, judgement, and communication [15]. Chronic stress erodes a surgeon's delivery of patient care, encourages evasive behaviour, undermines well-being, and carries chronic mental

Table 2 The self-reported mood measure [5] was used to assess mood at points 1–4 (Fig. 1)*How do you feel at the present moment? (There are no correct or incorrect answers)*

1	2	3	4	5
Happy				Sad
Calm				Nervous
Relaxed				Anxious
Energetic				Tired
Alert				Sleepy
In control				Overwhelmed
Optimistic				Pessimistic
Hopeful				Worried
Patient				Impatient
Confident				Insecure

and physical health risks [1, 16]. The devastating effects of the COVID-19 pandemic on the delivery of planned surgical care in particular have been far-reaching [17]. This has impacted the training environment and well-being of surgical trainees as a direct corollary [17].

Strategies to reduce the perception and impact of stress can be ‘coalmine’ (institution and systems) or ‘canary’ (individual) based [3, 6]. Whilst addressing institutional or systemic stressors is critically important [18], it is increasingly evident that individual factors are equally or even more so [19] and that, far from being purely innate, characteristics such as resilience and optimism can be nurtured and taught [16, 20].

How a person deals with failure is more important for well-being and personal growth than how much success they enjoy. Resilience (from *resilio*, to bounce back) describes an individual’s ability to cope with, and learn from, adversity [16]. Resilience counteracts stress sensitivity [1], and correlates to sustained prefrontal cortex (PFC) activation, an area of the brain important for concentration, attention, goal-directed behaviours, and executive function [2, 15]; all crucial for surgeons. Stress-related neural or hormonal signals, task-irrelevant thoughts, or concerns about failure or time-pressure may deactivate the PFC, to the detriment of technical performance [2, 7, 15]. While various personality and psychological traits predict resilience, it can also be developed, as is recognised in high-performance professions such as finance, aviation, elite sport, and music [7, 20, 21].

Mindfulness training has proven to be a flexible, accessible, and effective tool for developing resilience and activating the PFC [2, 6–8].

Mindfulness describes moment-to-moment awareness cultivated by paying attention non-reactively and non-judgmentally to the unfolding of an experience [22]. It trains the mind to sustain its focus and undivided bandwidth [7], despite environmental and internal distractions, and act consciously, in contrast to ‘mindless’ habitual function [13]. This does not mean that automatic, intuitive processes, which can save time and lives in surgery, do not occur; on the contrary, more mindful individuals may also be more attuned to these [4]. By being less judgmental, individuals can nurture process—rather than outcome—focus, reducing anxiety and the perception of stress, improving resilience, technical performance, and outcomes [15].

People differ in how mindful they inherently are. This so-called ‘trait’ mindfulness is most commonly measured by the MAAS [23]. Higher trait mindfulness is associated with better psychological and physical health, resilience, optimism, fulfilment, self-esteem, autonomy, and competence [4, 24]. Lower trait mindfulness is associated with neuroticism, negative affect, anxiety, depression, self-consciousness, rumination, and experiential avoidance [4, 23]. Regular meditation is associated with an improved MAAS score, particularly if it is carried over into daily life [4]. In their 2003 paper, Brown and Ryan found the MAAS of 74 Zen practitioners to average 4.29, while a matched general population control averaged

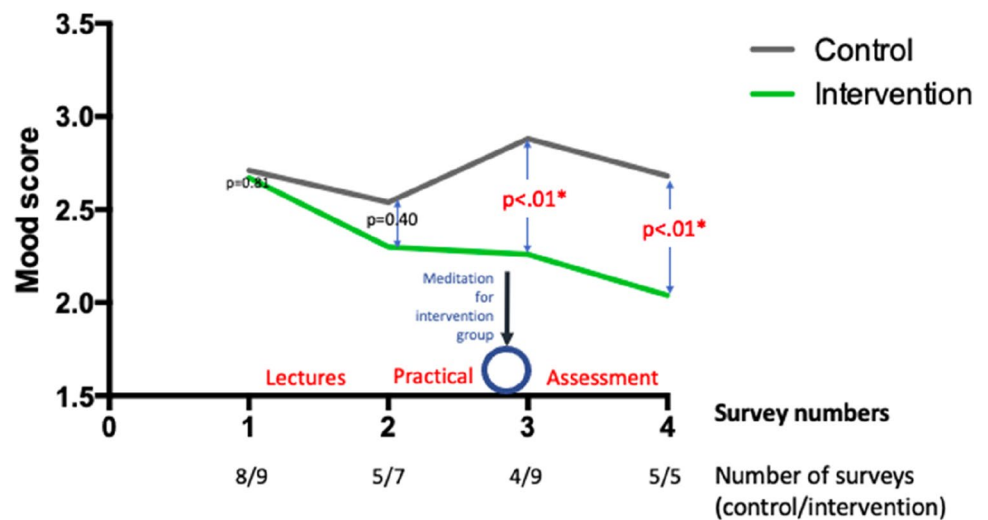
Table 3 Demographic differences between the two groups

	Group 1 (control, n=8)	Group 2 (intervention, n=9)	Statistical test
Number female (%) :	5 (63%)	5 (56%)	$p=0.79^i$
Age group:			$df=1.63^{ii}$
< 30	6	4	$p=0.20^{ii}$
30–35	2	5	
Training grade			$df=5.00^{ii}$
SHO	6	6	$p=0.17^{ii}$
SpR < 3 years	0	3	
SpR > 3 years	1	0	
Fellow	1	0	
Previous experience			
Previous 5th metacarpal K-wiring:			
Observed mean (SD)	3 (3.29)	8 (5.59)	$p=0.08^i$
Contributed to mean (SD)	2 (1.67)	3 (1.94)	$p=0.38^i$
Performed mean (SD)	1 (1.77)	0 (0.33)	$p=0.40^i$
Other hand K-wiring:			
Observed mean (SD)	10 (11.78)	16 (15.75)	$p=0.34^i$
Contributed to mean (SD)	7 (11.67)	10 (8.93)	$p=0.62^i$
Performed mean (SD)	3 (7.01)	4 (4.53)	$p=0.66^i$
MAAS score [10]: mean (SD)	3.77 (0.32)	3.5 (0.29)	$p=0.14^i$
Current meditation practice:			
Never	5	5	$df=4.00^{ii}$
Occasionally	1	3	$p=0.27^{ii}$
Sometimes	2	0	
Often	0	1	
Daily	0	0	

ⁱUnpaired, 2-tailed *t* test

ⁱⁱ χ^2 test

Fig. 2 A line graph of the average mood scores of the control and intervention groups at the four survey points (Scale 1–5, Box 2)



3.97 [4]. The average trait mindfulness of the surgeons in the current study was 3.69 suggesting potential for further mindfulness development in this group. This could reasonably be extrapolated to apply to trainee surgeons in general.

Many practices exist to cultivate mindfulness, including repetitive sports and creative activities, but one of the most accessible, acceptable, and rapidly learnt is meditation [15, 25]. Lebares et al. (2018) randomised 21 American surgical

Table 4 Individual self-reported mood measure means for the two groups at survey 3

	Control mean	Intervention mean	<i>p</i> value
Happy–sad	2.25	2.11	0.70
Calm–nervous	3.00	1.89	0.02*
Relaxed–anxious	3.00	1.89	0.04*
Energetic–tired	3.50	3.22	0.65
Alert–sleepy	3.50	3.00	0.42
In control–overwhelmed	2.75	2.11	0.28
Optimistic–pessimistic	2.50	2.11	0.40
Hopeful–worried	2.75	2.00	0.19
Patient–impatient	2.50	2.00	0.24
Confident–insecure	3.00	2.22	0.10

trainees to 20 min' daily meditation and a weekly 2-h class for 8 weeks [8]. The intervention group experienced significantly less stress and increased well-being, resilience, executive cognitive function, and surgical skills, with reduced technical errors [8]. Post-intervention functional brain MRI scans demonstrated sustained cortical PFC changes and reduced amygdala activation and size in the meditation group [7]. Though the evidence in American trainees is compelling, there are no studies regarding the effect of meditation on surgical trainees in the British system in the literature, to the authors' knowledge.

In this study, the single 10-min meditation improved trainees' self-reported mood score (Fig. 2), particularly in the calm–nervous ($p=0.02$) and relaxed–anxious ($p=0.04$) domains (Table 4), as expected [5]. This was the case despite

the anticipatory stress of an impending time-limited assessment, a reliable stressor [15]. It may have been particularly stressful for the intervention group since they were (non-significantly) more junior [1], though, due to their longer day, they may equally have been more rested or relaxed than the control group. The sustained effect on mood at time point 4 (Fig. 2) differed from that of previous studies in veterinarians where the impact of a one-off meditation session normalized by 30–40 min post intervention [5], and would be expected to normalise over time.

Mindfulness is thought to increase situational awareness [26]. It was therefore surprising that only one (14%) of the intervention group, compared to four (57%) of the controls, correctly identified the blue sticker on the K wire box present for the first 10 min of the assessment. Further research is required exploring factors affecting surgeons' situational awareness and inattention blindness [27] as individuals, and during the learning curve of meditation practice.

The surgeons in this study appeared to benefit from the meditation intervention (Fig. 2, Table 4). Why then, if participants felt that meditation could be useful in surgical training (Fig. 3) had nearly 60% 'never' used it? Once the intervention groups had experienced it first-hand, they became significantly more confident than the control group about the potential of meditation in improving surgical training and performance ($p=0.03$), and in fitting their ethical values ($p=0.02$). This was concordant with the free text comment: "I regularly meditate already and find it very helpful. I feel it should become part of daily life and surgical practice". While they felt more likely to be able to perform meditation regularly, the intervention group particularly

	Not at all 1	2	3	4	Extremely 5	<i>p</i> value
Survey 1: Do you think that meditation could be a useful addition to surgical training?				3.6 3.7		.86
Survey 4 from here onwards: How effective do you think that meditation might be in improving surgical training/performance?		2.5	3.3			.03*
How effortful would it be for you to regularly meditate?		2.5	3.3			.08
How confident are you that you could commit to regularly perform meditation?	1.6	2.25				.32
How well does the use of meditation fit with your value system/ethical stance?		2.3		3.6		.02*
How well do you understand how meditation works?		2.3	2.7			.49
Do you feel that an associated financial/time cost incurred in regular meditation is acceptable to you?		1.9	2.7			.19

Fig. 3 Acceptability scores for the use of meditation in surgical training (before (Survey 1) and after (Survey 4) the intervention). Grey highlighting represents the control, and green the intervention group

appreciated that it would take effort to implement, potentially having directly experienced the intervention.

Issues exist around the practicalities of delivering meditation to surgeons, particularly at work. In designing a feasible programme, most would prefer to meditate alone (80%, cf. 36% in a group or community), often daily (39%), and at variable times of the day. A total of 29% would like a safe place at work to meditate. Careful planning with culturally tailored mindfulness interventions and respected leadership would be essential in delivering this change. A strong focus on practicality and relevance to surgeons' needs would be needed with flexible meditation options, and adequate infrastructure to support their use. Qualitative feedback and focus groups with agile adjustments would help to refine the intervention over time [9].

This study was limited by small numbers, and technical issues with the online surveys unfortunately meaning that some of the mood scores had to be discounted due to late submission; this may have been due to issues with the hospital intranet. The participants also differed in their experiences of the lectures and the timing from theory to performance, due to a need for distancing resulting in the intervention group watching the lectures from home before attending an afternoon practical. Finally, this was an isolated meditation experience with a mood-based assessment tool and further studies are required with longer-term assessments of stress and patient outcome, as well as qualitative studies regarding acceptability and application in the British training system.

Conclusions

Optimising surgeon well-being is mandated on a human and professional level, and is a particular problem currently for surgical trainees during the COVID-19 pandemic [17]. Mindfulness meditation is a cheap, acceptable, and flexible cognitive training tool which can reduce the experience of stress, and improve performance, joy, and well-being within surgical training, to complement systemic and institutional efforts [4, 6–10]. This feasibility study suggests that surgeons in the British training system would be sensitive to its effects, and that it would be acceptable to them; adequately powered further work is required to identify the optimum length and intensity of meditation course for sustained effect, and to identify the incentives and barriers to its introduction.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s00238-022-01962-1>.

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Declarations

Conflict of interest Lilli Cooper, Theodora Papavasiliou, Lauren Uppal, and Charles Bain declare no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The Human Investigation Committee (IRB) of University B approved this study.

Informed consent Consent was sought from participants to allow sharing of the survey's data for this study.

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