Effect of e-feedback versus standard verbal feedback on the acquisition of surgical skills: a randomized controlled trial

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Abstract

Background: Constructive feedback plays an important role in learning during surgical training. Standard feedback is usually given verbally following direct observation by a trained assessor. The aim of this trial was to evaluate electronic feedback (e-feedback) after video observation of surgical suturing in comparison with standard face-to-face verbal feedback.

Methods: A prospective, blinded, randomized clinical trial comparing e-feedback with standard verbal feedback was carried out. Validated pro formas for assessment were utilized and quality control was performed by independent expert assessors. Trial participants were recorded on video performing the surgical skill, filled self evaluation form and received e-feedback on the same day (group 1) or observed directly by an assessor and received standard verbal feedback alone (group 2). The participants returned 2 days later and performed the same skill again.

Results: From a maximum achievable score of 20, there was significant improvement in the overall mean score on the second performance of the task (first performance mean 11.59, second performance mean 15.95; $P = < 0.0001$). There was no statistical difference in the overall mean improvement score between group 1 and group 2 (4.74 and 3.94, respectively; $P = 0.4927$). The mean improvement scores for the specific tasks were also not significantly different between the two groups except for the mean improvement score of needle handling, which was significantly better in the e-feedback group. The mean overall scores for the e-

feedback group recorded by two independent investigators showed good agreement (mean overall scores of 12.84 and 11.89; Cronbach α: 0.859). From a maximum score of 5, both e-feedback and standard verbal feedback achieved high mean Likert grades as recorded by the participants (4.42 (range 2-5) and 4.71 (range 4-5) respectively; P= 0.274).

Conclusion: e-feedback after watching a video is reliable, acceptable and equally effective to standard verbal feedback in improving the acquisition of surgical skills.

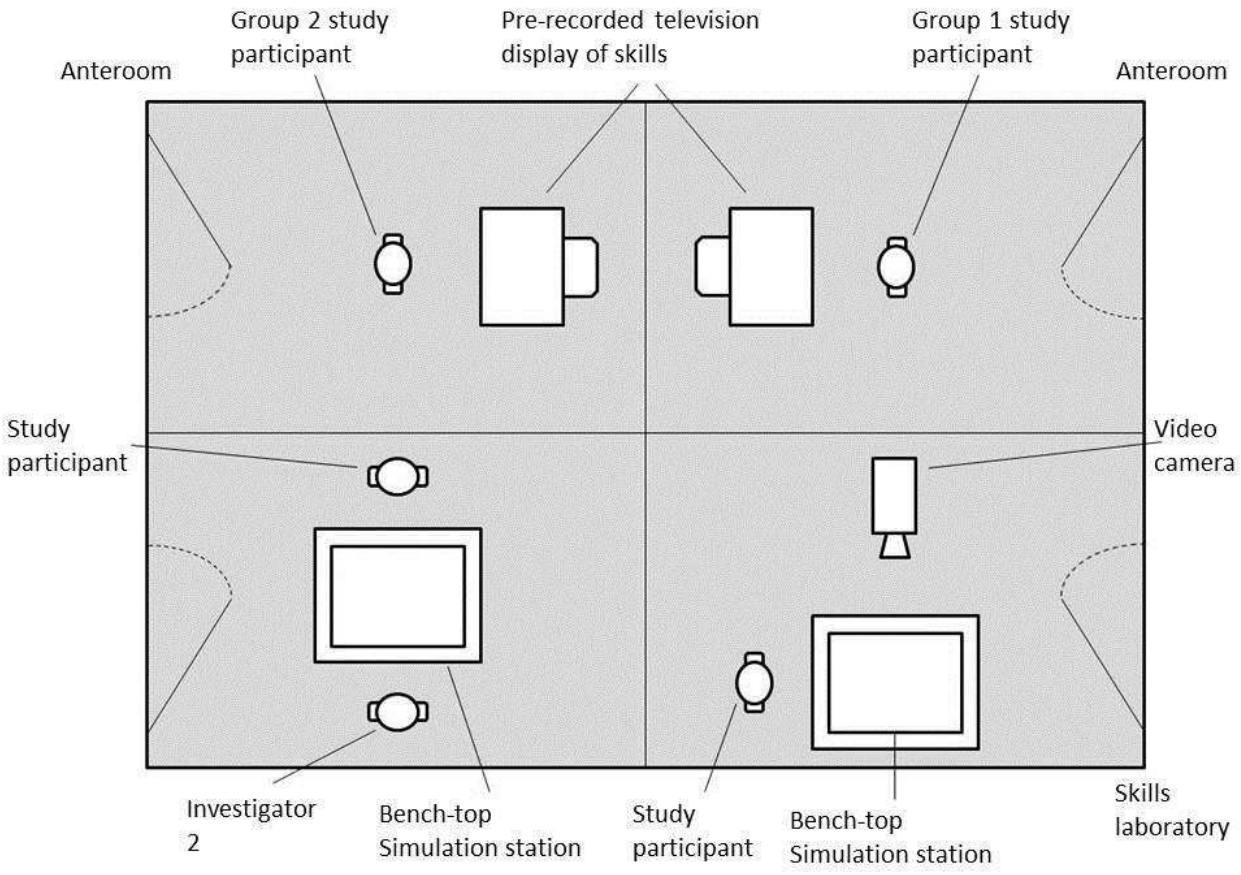
Introduction:

Clinical feedback is defined as “specific information about the comparison between a trainee’s performance and a standard, given with the intent to improve the trainee’s performance [1]”. Such feedback is fundamental for reinforcing learning when teaching surgical skills. The effectiveness of this feedback is dependent upon objective assessment, during direct observation, using a structured pro forma in a formal setting such as an Objective Structured Clinical Examination (OSCE) or in a training setting with tools such as Objective Structured Assessment of Technical Skill (OSATS). Assessments incorporated into OSCEs and OSATS are accepted as the standard for objective skills assessment [2]. Standard feedback is delivered verbally after direct observation of surgical skills; however, this requires physical presence of faculty, increasing the costs and valuable time of NHS staff. The recent national student survey [3] revealed that across the UK, and in all undergraduate curricula, students are unhappy with the amount of feedback they receive from their respective faculty, yet most demonstrate good insight and empathize at the difficulties teachers encounter at providing effective feedback [4]. Both teachers and students recognize that time and resources are limiting factors, which can make individualizing feedback difficult. Technology has been implemented in various applications in training and simulation. Reviewing a recorded skill to provide video feedback can improve the acquisition of surgical skills [5], however, utilizing video recording to provide remote e-feedback by a trainer in this context has not been investigated before. We plan to utilize e-feedback as a novel way of incorporating feedback for teaching procedural skills with the potential benefit of overcoming time and cost barriers of providing faculty. We present a randomized controlled trial (RCT) that aimed at comparing e-feedback with standard verbal

feedback during the acquisition of a basic surgical skill by novices. A validated pro forma was used to standardize the assessment and then feedback of the surgical skill. Minor modifications to the checklist were performed to make the pro forma applicable to the context of novices performing surgical suturing. An integral factor of an OSATS is the use of predefined pro formas against which the performance of a specific surgical skill can be measured and subsequent constructive feedback can be provided [6].

Methods:

This prospective RCT was conducted over 3 days in February 2015 at the University of Sheffield. Ethical approval for the study was sought and granted via the University of Sheffield Ethics Committee process. The study participants were undergraduate medical students who were assigned to an Integrated Learning Activity (ILA) relating specifically to surgical skills as part of a Student Selected Component of the undergraduate curriculum. Students were informed that the ILA would include participation in a scientific study and advised not to apply if they did not wish to take part. Verbal consent for inclusion in the study was obtained. Students attended the Clinical Skills Centre at the Northern General Hospital, Sheffield, and received instruction on the performance of a basic surgical skill (skin suturing on a latex pad) in video format in a room separate from that used for the skill assessment. The layout of the facilities is illustrated in Fig. 1.



Investigator 1 (medical illustration professional) randomly allocated students, using presealed envelopes marked anonymously by a study assistant, to group 1 or 2. Two students were enrolled at a time with one randomized to the e-feedback arm (group 1) with his/her performance video recorded without the presence of a surgical trainer, while the other student was randomized to the standard feedback arm (group 2) where the performance of the skill was assessed by a surgical trainer (investigator 2) immediately after instruction. A standard, validated assessment pro forma derived from those developed by Reznick [7] for OSATS with minor modifications to suit the context of undergraduate assessment was completed for group 2 participants by investigator 2 (Fig. 2).

This comprised both a task-specific checklist and a global rating score, providing each performance with an overall score of technical performance. The procedure performed by each of group 1 participants was recorded on to a DVD by investigator 1 in an adjacent room. Each participant was given a maximum of 10 minutes to complete the task, then each student in group 1 was asked to fill a self assessment pro forma (Fig. 3) while group 2 students received face-to face standard verbal feedback with investigator 2 based on the assessment pro forma and then was given a copy of the form to take home.

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WOUND SUTURING
TIME: MAXIMUM 10 Mins

Instructions to candidates:

- Using the skin pad provided, please close the wound with 3 interrupted sutures using the suture and needleholder provided
- Use the suturing technique on the video with instrument-tied knots

TASK SPECIFIED CHECKLIST	**Not done, Incorrect**	**Done, correct**
Position needle correctly in needle holder	0	1
Skin edges grasped gently without damage	0	1
Uses curve of needle to minimise tissue injury	0	1
Sutures placed evenly about 5 mm from skin edges and 5 mm apart	0 or 1	2
Good opposition of skin edges without undue tension	0 or 1	2
Secure knots with at least 3 throws in different directions	0 or 1	2
Cuts sutures at least 0.5 cm long	0 or 1	2
Needle handled with instruments most of the time	0 or 1	2
Needle placed in sharps bin at end of procedure	0	1
Good economy of movement	0	1
Controls instruments well	0 or 1	2
Shows an organised approach to the task	0	1
Proceeds in an unhurried but timely way	0	1
Completes the task in the time available (10 min max)	0	1
Total Score (MAX 20)		

Candidate Number / Name: Date: / /

Assessor's name: Signature:

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WOUND SUTURING

FEEDBACK FORM

Candidate Number / Name: Date:

TASK SPECIFIED CHECKLIST	Comments
Position needle correctly in needle holder	
Skin edges grasped gently without damage	
Uses curve of needle to minimise tissue injury	
Sutures placed evenly about 5 mm from skin edges and 5 mm apart	
Good opposition of skin edges without undue tension	
Secure knots with at least 3 throws in different directions	
Cuts sutures at least 0.5 cm long	
Needle handled with instruments most of the time	
Needle placed in sharps bin at end of procedure	
Good economy of movement	
Controls instruments well	
Shows an organised approach to the task	
Proceeds in an unhurried but timely way	
Completes the task in the time available (10 min max)	

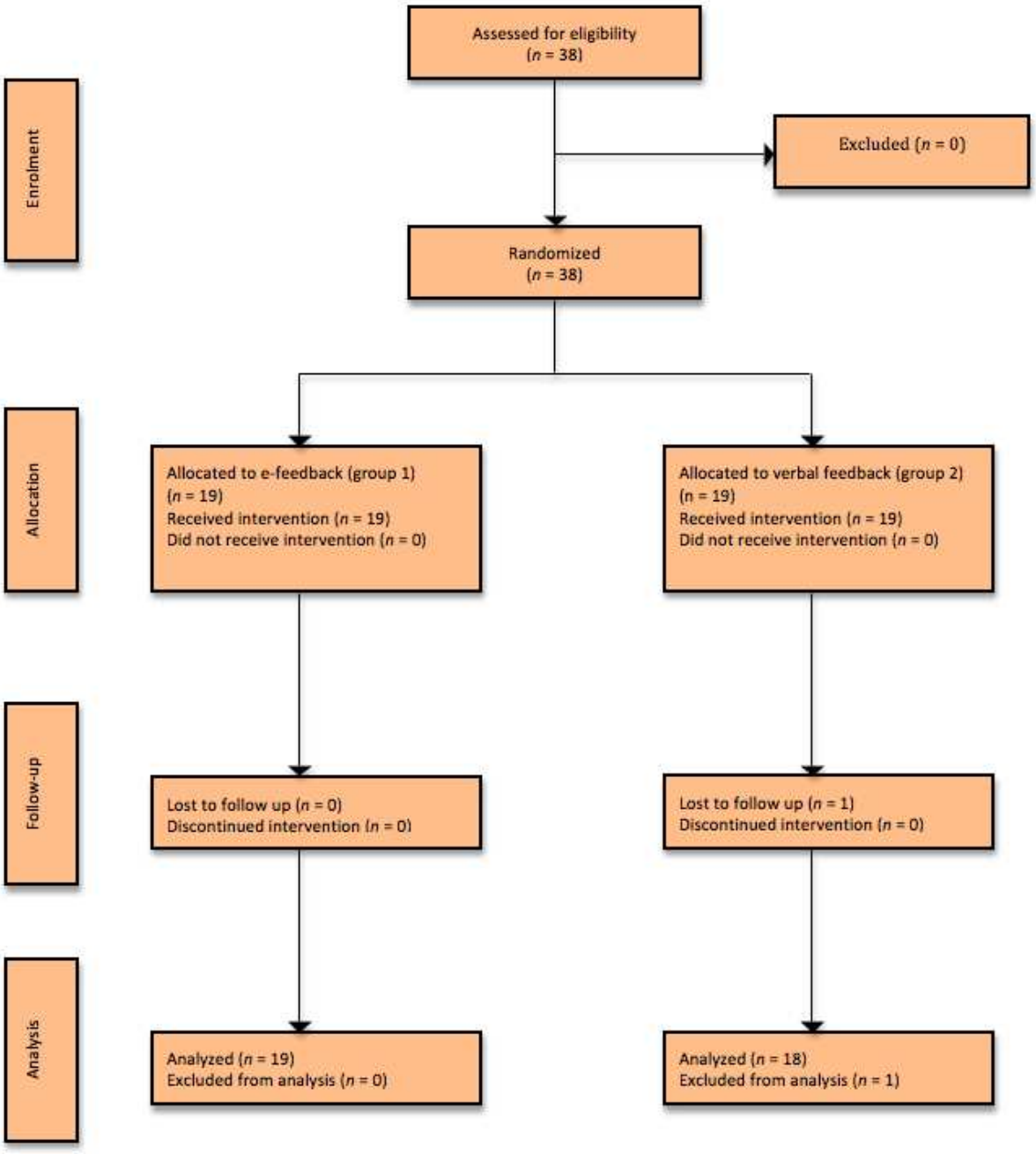
Suggestions for improvement

Assessor's name: Signature:

The students were advised not to meet with other students waiting to perform the task to prevent contamination. All DVDs of group 1 were then observed by investigator 2 and assessment pro forma and e-feedback -based on the assessment pro forma for each participant- were filled. The latter was sent to each participant in group 1 by email. Both groups returned to the same Clinical Skills Centre 2 days later at a similar session time. Investigator 1 confirmed that all participants in group 1 have received the e-feedback and read it. Each student then from both groups performed the skill again and was reassessed by an independent assessor (investigator 3) who was concealed to the randomization and utilized the same assessment pro forma. After completion of the skill, each student received face-to-face standard verbal feedback, based on the same pro forma, and was given a copy of the form to take home. All the students filled an anonymous end of study questionnaire that asked them to rate their feedback on a 5-point Likert scale [7], with 1 representing 'poor feedback' and 5 representing 'excellent feedback'. In addition, they had open text space for further comments. Following the exercise, an independent assessor (investigator 4) observed group 1 DVDs and filled separate assessments for the participants to evaluate inter-rater variability as a secondary outcome. Data were collected in an electronic Microsoft Excel database (Microsoft, Redmond, Washington, USA). Two tailed paired t test was used for comparing scores before and after feedback within each group, while unpaired t test was used for comparison of performance scores between group 1 and group 2. The Cronbach α was used to test for the assessors of e-feedback inter-rater variability. Mann-Whitney U test was used when comparing groups' post trial questionnaire response scores. $P \leq 0.050$ was considered statistically significant.

Results:

Thirty-eight participants from the final year of the medical undergraduate degree course at the University of Sheffield, UK, were included in the study (Fig. 3). One student in group 2 did not attend the second day and was therefore excluded from the analysis.



There was a significant improvement in the overall mean score on the second performance of the task (first performance mean 11.59, second performance mean 15.95; P = < 0.0001) (Table 1). From a maximum achievable score of 20, there was no statistical difference in the mean improvement score between group 1 and group 2 (4.74 and 3.94, respectively; P = 0.4927). Analysis of specific tasks showed similar trend. There was significant improvement in most

specific tasks within each group compared to baseline, however, there was no significant difference between group 1 and 2 in mean improvement of all the domains except needle handling, which was significantly better in group 1 compared to group 2 (0.895 versus 0.5, respectively, P = 0.197). The mean overall scores for the e-feedback group recorded by two independent investigators showed good agreement (mean overall scores of 12.84 and 11.89; Cronbach α: 0.859). From a maximum score of 5, both e-feedback and standard verbal feedback achieved high mean Likert grades as recorded by the participants (4.42 (range 2-5) and 4.71 (range 4-5) respectively; P= 0.274). Only 1 student gave a grade of <4 to e-feedback with a free text comment that read "the feedback was not very helpful, I have forgotten what I had done by the time I received it, I would rather have a demonstration of what is correct". The rest of the free text comments are summarized in table 2.

	Mean score		Mean improvement	
	Before feedback	After feedback	e-feedback	Verbal feedback
Needle position	0.432	0.865*	0.421*	0.444*
Skin edges grasped gently	0.730	0.460*	-0.368*	-0.1667
Uses a needle curve	0.351	0.568*	0.105	0.333*
Even suture placement	1.06	1.54*	0.474*	0.5*
Good skin opposition	0.919	1.65*	0.895*	0.556*
Secure knots (minimum 3 throws)	1.30	1.84*	0.474*	0.611*
Cuts sutures at least 0.5 cm long	1.22	1.78*	0.737*	0.389

Needle handled with instruments	1	1.70*	0.895*†	0.5*
Needle placed in sharps bin	0.595	0.703	0.158	0.056
Good economy of movement	0.622	0.432	-0.263*	-0.111
Controls instruments well	0.973	1.76*	0.842*	0.722*
Organized approach to the task	0.784	0.973*	0.158	0.222
Unhurried but timely progress	0.730	0.811	0.263*	-0.111
Completes the task in time	0.892	0.946	0	0.111
Score	11.59	15.95*	4.74*	3.94*

*$P < 0.05$ (Two tailed paired t test for comparing overall scores before and after feedback as well as before and after feedback within each group)

†$P < 0.05$ (unpaired t test was used for comparison of performance scores between group 1 and group 2)

	e-feedback	Verbal feedback
Free text comments	"Less pressure with no one watching" "Convenient to receive via email" "e-feedback several hours later so I can't remember the details of my performance" "Good to refer to again before repeating the task" "Permanent electronic copy of my assessment is convenient" e-feedback did not allow for questions" "I can put in e-portfolio" "It's hard to visualize written feedback" "Very useful" "Good concise feedback" "Having no direct observation helped my tremor!" "Not being face to face allows feedback to be more openly critical"	"I had the chance to ask questions and be sure I understood the comments" "Feedback was very useful" "More feedback during process rather than at end would be preferable" "Having instant feedback allows for more discussion of the task and visual guidance which improves memories of the feedback"

Discussion

This study suggests that e-feedback after watching a video and without the physical presence of a trainer, improves acquisition of the surgical skills. A recent study from Sheffield [5] demonstrated absence of quantitative improvement following standard feedback. Hence, in our current study we allowed for a longer time of face-to-face verbal feedback, provided by a qualified trainer who possesses a postgraduate degree in medical education, supported the feedback with demonstration when needed and gave the students structured written feedback summary to take home. This resulted in improvement in group 2 score by 3.94 points compared to previously published improvement of 0.25 point with verbal feedback [5]. The effectiveness of the e-feedback was equivalent to standard feedback in our study. It was noticeable that the fundamental surgical skills (handling and positioning the needle, instrument familiarity and control) improved in both groups, whereas there was some decline in economy of movement in both groups. This could be potentially due to the more concentration paid by the students to achieve the expectations on the second attempt after the feedback, resulting in more time consumed on each surgical step.

Good correlation has been found between video and live assessment [8]. In our study, both investigators who performed video assessment of group 1 students had good agreement when the overall mean scores were compared. Such reliability of video assessment in surgical skills along with the established construct validity by other groups [9,10] (whether a test actually measures the trait it is supposed to measure) provide evidence to support the utility of such an assessment method.

This study is not without limitations. Although we chose novices without previous surgical experience to maintain internal validity, other sources of potential bias exist. Audience effect [11] has been reported previously to affect performance in the presence of video recording. This could have affected group 1 with either improved performance in the student's desire to do well, or impaired performance owing to anxiety. This was reported by one of the students who indicated that the absence of physical trainer helped to relieve tremor. Limitations of e-feedback were also highlighted by some of the students such as the lack of instant feedback after performing the skill and inability to ask questions. Previous studies have suggested that feedback immediately after performing a task is most beneficial, and how the feedback is provided and its content are also key components [12]. On the other hand, sparing the presence of an assessor is an important advantage of e-feedback, particularly with the current limited resources to provide such expensive experts who have already busy daily schedule. Combining the advantages of e-feedback with the previous reported advantage of video feedback [5] could stimulate the production of a novel method for learning surgical skills through tablet or smartphone application that offer students the ability to record their performance, watch it (video feedback), record a self assessment, and then send it to an assessor who has the same application and can provide remote e-feedback. This has the potential to extend to surgical trainees who can record their performance during laparoscopic or endovascular procedures. Hence, utilizing video and multimedia distribution platforms can be an important addition to both undergraduate and postgraduate surgical curricula and training.

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Legends:

Figure 1: Layout of the facilities used for data capture in the study. The participants watched the prerecorded video footage of the skill in the anterooms, and then performed the skill in the skill laboratory rooms. The two groups were separate all the time and the participants made their way directly to the exit without returning to the anteroom.

Figure 2: Validated assessment pro forma used for data collection

Figure 3: Feedback form used for both standard feedback and e-feedback

Figure 4: CONSORT diagram for the trial

Table 1: Scores for each task before and after feedback, and mean improvement in standard feedback and e-feedback groups. There was no significant difference between group 1 and group 2 in the overall mean improvement score as well as in the mean improvement score of each task except for handling needle with instruments. There was significantly higher mean improvement in the e-feedback group.

Table 2: End of study free text comments from participants