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Do Workshops Improve the Technical Skill of Vascular Surgical Trainees?

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Aims. *Adjuncts to conventional surgical training are needed in order to address the reduction in working hours. This purpose of this study was to objectively assess the efficacy of workshop training on simulators.*
Methods. *Fifteen consecutive participants of the European Vascular Workshop in 2003 and 2004 were recruited to this study. Participants performed a proximal anastomosis on a commercially available abdominal aortic aneurysm simulator, were then given intensive training on sophisticated models for 3 days and re-assessed. Pre- and post-course procedures were videotaped and independently reviewed by three assessors (tapes were blinded and in random order). The operative end product was similarly assessed. Four measures of technical skill were used: generic skill, procedural skill; a five point technical rating of the anastomosis (assessed using validated rating scales) and procedure time. Non-parametric tests were used in the statistical analysis.*
Results. *The video assessment scores for aneurysm repair increased significantly following completion of the course* ($p = 0.006$ *and* $p = 0.004$ *for generic and procedural skill, respectively). End product assessment scores increased significantly post-course* ($p = 0.001$) *and participants performed aneurysm repair faster following the course* ($p < 0.05$). *Inter-observer reliability ranged from* $\alpha = 0.84$–0.98 *for the three rating scales pre- and post-course.*
Conclusion. *Objective improvements in technical performance follow intensive workshop training. Participants' perform better, faster, and with an improved end product following the course. Such adjuncts to training play an important part in a focused integrated programme that addresses reduced work hours.*

Keywords: Workshops; Training; Vascular; Surgical; Assessment; Education; Simulator; Technical skill; Clinical competence; OSATS; ICEPS.

Introduction

The European Working Time Directive (EWTD) promises to bring reduction to work hours throughout Europe.[1,2] This will have a direct effect of those working in the medical profession. Training in non-surgical specialties may not suffer greatly: technological advances allowing some the freedom to work from home, communication with multimedia worldwide and increasing online resources ensure that heath professionals stay ahead in their chosen profession.

Training in the surgical specialities will, however, be adversely affected. A dramatic decrease in the number of hours spent in training[3] will in some countries lead to the production of less experienced (and some may extrapolate, less competent) surgeons at the end of a training programme.

Measures are required to ensure that newly appointed consultant surgeons are competent independent practitioners and to ensure that surgical training is adequate. The first may be answered by the use of in-training assessment,[4] accreditation of surgical logbook data[4–6] or a formal assessment of technical skill.[7] Unless we ensure that surgical training remains vigorous, these standards will not be met.

Service and training are inextricably linked[8] and technical skills are currently taught during service operations with all the pressures that this implies. It is also recognised that each surgeon has his own learning curve. If surgical training time is reduced, will some surgeons complete their training at a lower point on their learning curve? The safety of patients is paramount. Before a pilot flies, he must first practice on a simulator but surgical trainees must practice in a

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stressful environment that is not always conducive to learning.

Vascular surgical training workshops purport to improve the technical skill of their participants so that they perform better in the operating theatre. Interest in clinical competence has led to the development of novel methods of measuring technical skill but the effect on technical skill from training in a vascular surgical workshop has not been previously measured.

Using established methods of assessment, the aim of this study was to measure improvement in technical skill of surgeons participating at the annual European Vascular Workshop in Pontresina, Switzerland.

Methods

Participants at the European Vascular Workshop are given supervised tuition on aortic, infra-inguinal and endovascular procedures (Fig. 1). An expert vascular surgeon demonstrates each procedure by means of a live telecast throughout the workshop. Sophisticated abdominal and infrainguinal simulators developed by the University of Zurich allow supervised practice. Hands-on training is emphasised and in the abdominal and groin reconstruction component of the course with the current framework for the course each participant performs 12 supervised anastomoses.

Fifteen consecutive participants of the workshop held in 2003 and 2004 participated in this study. Seniority and previous experience in abdominal aortic aneurysm repair was recorded by means of a questionnaire and accredited using the method used by the European Board of Vascular Surgery. Each participant had a pre-course assessment on a commercially available abdominal aortic aneurysm simulator (Annexart, UK). They were then given high intensity training over a 3-day period on the abdominal and groin component of the workshop. Following completion of the course they had a repeat assessment of competence on the original model.

Pre- and post-course assessments were blinded, videotaped and randomised. Each procedure was independently assessed by three vascular surgeons. Marking utilised previously validated rating scales, the objective structured assessment of technical skill (OSATS) global rating scale assessing generic surgical skill[4,9] and the Imperial college evaluation of procedure-specific skill (ICEPS)[7,10,11] assessing procedural content. Procedure time was recorded and the simulated operative end product was assessed using a rating scale for vascular anastomoses (EEVA; end-product evaluation for vascular anastomoses) modified for abdominal aortic aneurysm repair. We undertook a further analysis to define which components of technical competence improved most significantly.

Unblinded data was assessed using non-parametric tests. Wilcoxan signed rank tests assessed the paired pre-and post-course assessments. Spearman's rank test assessed the correlation between accredited operative data and technical performance. $p<0.05$ was considered significant. $p<0.01$ was considered highly significant.

Results

Pre-workshop experience of participants

Experience varied between participants. The total length of time spent in surgical training ranged from 2 to 10 years (median 7 years). This was reflected in the time spent in basic surgical training (0–4 years median 2 years), time spent in higher general surgical (0–6 years, median 1 year) and vascular surgical training (0–9 median 2 years). The level of experience measured using accreditation of operative experience also showed a considerable range for elective (9–183 accredited marks, median 22) and emergency (0–60, median 5) abdominal aortic aneurysm repair.

Generic skill

OSATS rating scale gives a global score ranging from 8 to 40 with 24 representing a competent performance. The average pre-course scores ranged from 10.3 to 36.3 (median 17.3). The average post-course scores were higher (12–33, median 26). The mean improvement in generic skill was 5.6 this was highly significant ($p=0.006$ Fig. 2).

Procedural skill

ICEPS rating scale gives a score between 8 (poor performance) and 40 (excellent performance) with 24 representing a competent performance. The pre-course scores ranged from 10 to 37 (median 17.3). There was an overall improvement post-course 13.33–32 (median 25). There was a mean improvement in procedural skill of 6.5. This improvement was highly significant ($p=0.004$ Fig. 2).

Inter-observer reliability

The agreement between the observers on generic skill

Fig. 1. The workshop, trainer performs procedure, a visualiser transmits the live video feed to each of the workstations. In addition feedback is provided by roving tutors.

(OSATS; Cronbach's alpha = 0.96), procedural skill (ICEPS $\alpha = 0.98$) and assessment of the end product (EEVA-AAA $\alpha = 0.92$) was high.

Assessment of end-product

The rating scale for the operative end-product (EEVA-AAA) assessed five parameters of the end-products; back wall and front wall, corner stitches integrity and overall technical quality on a five-point scale with descriptive comments to aid marking at points 1, 3 and 5 on the scale. The minimum score possible was five and the maximum 25. The pre-course scores ranged from 5 to 13 (median 7.67), there was an improvement post-course (7–19 median 14). This improvement was highly significant ($p = 0.001$ Fig. 3).

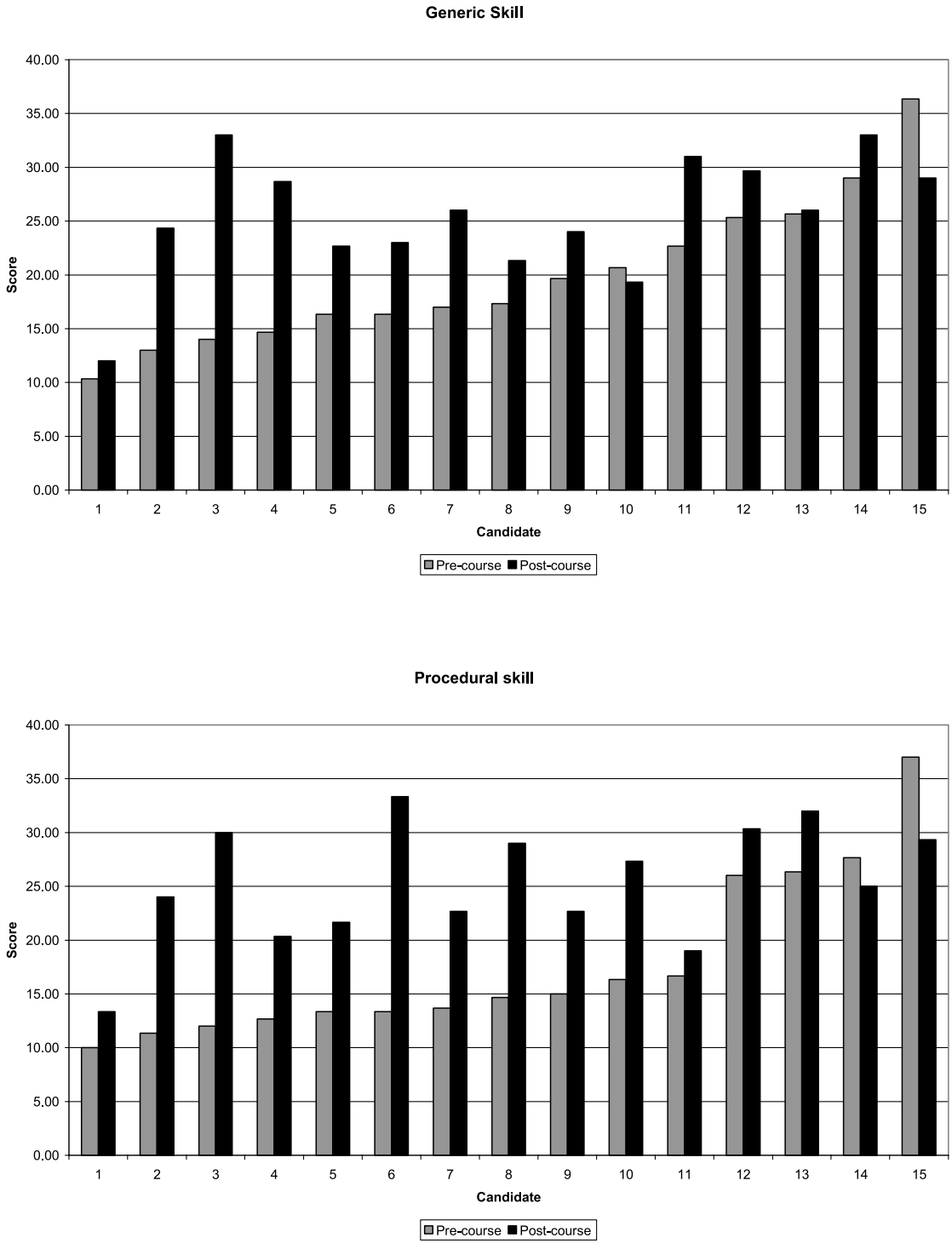

Fig. 2. Above, the improvement in generic surgical skill ($p=0.006$) and below, the improvement in procedural skill ($p=0.004$).

Procedure time

The time spent performing the proximal anastomosis ranged from 836 to 2261 s (median 1406 s). Participants performed this anastomosis faster post-course (729–1700 s, median 1095 s). The participants performed their post-course anastomoses on average 3 min and 40 s faster. This improvement was significant ($p=0.047$ Fig. 3).

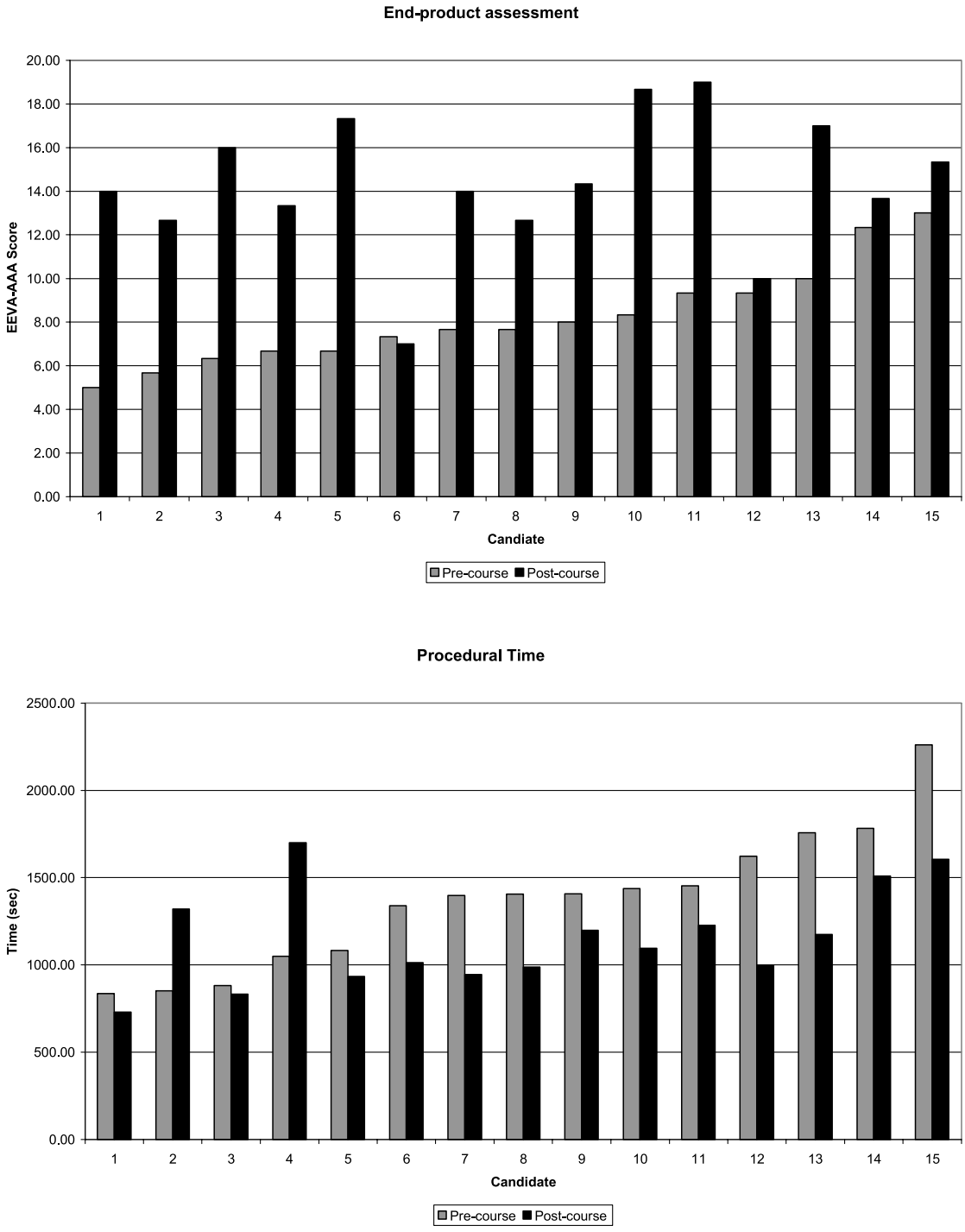

Fig. 3. Improvement in end product scores ($p=0.001$) above and reduction in procedural time ($p=0.047$) below, seen post-course.

Breakdown of rating scales

Respect for tissue ($p=0.041$), time and motion ($p=0.015$), instrument ($p=0.028$) and suture handling ($p=0.033$) as well knowledge of procedure (0.012) improved significantly. The flow of the operation ($p=0.004$) and overall performance ($p=0.007$) of the participant measured on the OSATS rating scale showed highly significant improvements.

Breaking down the ICEPS score allowed assessment of the operative components that improved after the course. Participants improved their performance of

the front wall of the aortic anastomosis ($p=0.03$), their needle and vessel handling showed significant improvements ($p=0.028$ and 0.014, respectively) the overall anastomotic technique of the participant also showed a significant improvement (0.016). Participants' ability to perform the back wall ($p=0.002$), corner stitches ($p=0.003$) and the anastomotic apposition ($p=0.006$) showed highly significant improvements.

Experience and improvement

There was no correlation with operative experience in aneurysm surgery and pre-course scores. There was a significant negative correlation between the pre-course score and improvement ($r_s=0.6$, $p=0.018$) so those with the lowest pre-test scores showed the greatest capacity for improvement. There was no statistical correlation between years in training with pre- or post-course test performance or improvement in score.

Discussion

This study demonstrates objective improvements in technical skill of candidates training on simulators. Few longitudinal studies on technical skill of surgical trainees exist. Workshops provide an ideal environment for conducting such a study as surgeons receive standardised teaching and if well planned, allow opportunities to perform pre- and post-course assessments.

Consecutive participants were recruited to the study, thereby avoiding selection bias. The constraints of time available to perform pre- and post-course assessments and the limited number of candidates on the workshops (to ensure a high tutor to participant ratio) meant relatively small numbers recruited to this study.

Despite the relatively small numbers in the study, significant improvements in performance were still identified using measures of technical skill previously shown to be good discriminators of skill.

One may question the value of training on simulators and few studies have been carried out to assess the transfer of skill from synthetic model to animal model. Anastakis *et al.* compared the effects of learning on cadavers as well as synthetic models versus learning from text. He concluded that teaching on cadaveric and synthetic models was superior to learning by text. The cadaveric and synthetic models had an equivalent effect on the transfer of skill. More recent work by Datta *et al.* compared the performance of surgeons performing a saphenofemoral junction ligation on bench model simulations with their performance in the operating theatre and found a highly significant correlation between the two.[12]

If there is such a correlation with performance in the operating theatre, it could be postulated that improvement on simulators will lead to improved performance in theatre. Proving an improvement would involve assessing each candidate in the operating room before and after attending the workshop.

The models used in the workshop are highly sophisticated and anatomically correct models developed in conjunction with the University of Zurich. End of course questionnaires continue to show that these models have high levels of realism (face validity) and most abdominal aortic and infra-inguinal procedures can be practiced on these models (content validity). Predicative validity (how performance on these models predicts future performance in theatre) would be ethically difficult to assess with the varying experience of the workshop participants. Concurrent validity (how performance on the models correlates with performance in theatre) is feasible but would be difficult to undertake with the different countries of origin of the workshop participants.

Due to the prohibitive cost of the models and the space required for the workshop, it is unlikely that individual institutions would be able to afford and sustain such workshops. Currently, a 4-day annual workshop is held in January and a shorter day course held concurrently with the annual meeting of the European Society for Vascular Surgery. The commercially available simulators currently retail at approximately €100 with the replaceable vessels retailing at €5, this more affordable solution is used for the Intermediate Surgical Skills course run by the Royal College of Surgeons of England. Such courses will surely become more common within individual hospitals and one can envisage surgeons practicing at home with the enforced reductions in work hours.

All aspects of the participants' generic skill were shown to improve. The most significant improvements were seen in the flow of the procedure and the overall performance of the participants. This repetition and reinforcement seems to result in a standardised approach to aortic anastomosis.

Procedure specific skill also improved significantly. The back wall, corner stitching and anastomotic apposition components of the rating scale showed highly significant improvements, reflecting the additional teaching time spent on this component of an aortic inlay graft.

Assessment of operative end product has been shown to correlate with technical performance[13–15]

and allows a quick and simple means of assessing training. Particular areas of the anastomosis can also be discussed with the trainer. Perhaps more emphasis should be placed on the end product, since a good post-operative result is more important than the means by which it was reached. Significant improvements in the end product were seen in the study.

Speed has always been considered (many consider wrongly) an important quality in a surgeon and surgical trainees faces pressure from anaesthetic staff and management to perform a quick procedure. With surgical experience, speed reflects economy of movement rather than haste. We, therefore, believe that the improvements in operative time reflect a systematic and economic way of performing an aortic inlay graft.

Despite statistical improvement with pre- and post-course assessments, Closer inspection of Figs. 1–3 revealed some surgeons that did not improve. Analysis for these surgeons' data revealed that they had the greatest pre-course experience. This data can be interpreted as older surgeons are less able to learn in this setting but is more likely to be due to efficient methods of performing this procedure that have accumulated over time. This course teaches a standard way of performing the anastomosis that more experienced surgeons may not be as familiar or comfortable with.

No correlation was seen between accredited operative data and technical performance. The negative correlation between pre-course performance and improvement suggest that those with lower levels of performance may benefit most from training in this environment. However, there was no correlation between the number of years in surgical training and improvement suggesting that most levels of skill benefit.

This study demonstrates the advantages of operative training in a workshop away from the pressures of the operating theatre. Such workshops as part of a structured educational program may help us to continue to deliver the vascular surgical service that the public deserves.

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