Skills training using multimedia and models

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All doctors need basic surgical skills. Learning and retaining such skills requires repeated practice. This article describes structured training provided by a multimedia computer program combined with practice on simulated tissue models.

BACKGROUND

Any doctor may be required to carry out a simple surgical procedure, ranging from closing a wound to removing a skin lesion. It is widely assumed by the public that training in these techniques forms part of basic undergraduate medical training. However, this is not always the case, and there is wide variation in competence between individuals when they qualify. Moreover, many doctors and students lack confidence about their level of skill (Pringle et al, 1991; Lowy et al, 1993; McMahon et al, 1995; Carlisle, 2000).

Training in surgical skills is a topical issue. Recent high-profile cases have turned the spotlight onto deficiencies in current training methods (Smith, 1998; Darzi et al, 1999). The traditional apprenticeship model is widely seen to contain flaws, and the changes brought about by the Calman report have reduced the time available for specialist training.

Effective training is the key to safe practice, but there is disagreement about what such training should consist of. The traditional way to learn any procedure is to carry it out on a patient under the guidance of an experienced colleague — the time-honoured 'see one, do one, teach one' approach. This provides invaluable experience and remains a keystone of training. However, in order to be acceptable to the public and the profession, this requires an initial level of basic competence on the part of the learner.

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In recent years, the use of skills workshops has become widespread. Small groups of learners practise the components of surgical technique on a variety of substitutes for real patients. In the past, animal tissue was the mainstay of training, but in recent years this has steadily been supplanted by increasingly sophisticated simulated tissue models. Lifelike models made from non-biological materials allow an ever-widening range of procedures to be practised in skills centres, and most hospitals now provide such facilities.

The crucial point here is that the focus of attention must shift to the educational needs of the learners, rather than the clinical needs of the patient (Kneebone, 1999). This allows participants to identify their learning needs and to concentrate on meeting them without jeopardising patient safety. Once they have established baseline competence they can then progress to supervised clinical experience under the guidance of a more experienced colleague.

This article examines recent extensions of this approach.

KNOWLEDGE, SKILL AND JUDGMENT

Competency in surgical procedures involves a strong practical element. Numerous psychomotor skills are needed, and these must be practised regularly. In addition, however, there is an important component of knowledge. For example, simply having the skill to remove a skin lesion is not in itself sufficient for safe practice. It is also necessary to know the likely diagnosis, possible differential diagnoses, important anatomical structures related to the area, possible complications of the procedure and so on.

Moreover, judgment is required to know when to carry out a procedure, when to refer to a more experienced colleague, or when to advise the patient that no procedure is needed. Skill and dexterity must therefore be acquired within a sound clinical context.

There is a clear analogy here with learning a musical instrument, where mastering scales and other technical exercises only has meaning within the context of choosing, perfecting and finally performing a piece of music.

LEARNING A SKILL

It is generally accepted that becoming expert in any skill requires sustained deliberate practice over many years (Ericsson et al, 1993). This practice must focus on improving performance, and simply repeating a procedure many times is not enough to guarantee proficiency. This applies as much to developing surgical skill as to learning a musical instrument or mastering a sport.

Experience plays a key role in learning. Kolb's widely known work on experiential learning emphasizes the cyclical interaction between experience, reflection, theory development and further action (Kolb, 1984).

Timely, focused feedback is known to have a powerful positive effect upon learning (Lee et al, 1994). Ideally, therefore, all learners would have the benefit of immediate feedback from an experienced tutor. This of course is not always feasible.

One possible solution is to take advantage of the powerful effect of modelling on the development of

expertise (Reznick, 1993; Custers et al, 1998). Watching an expert perform a procedure has a significant effect upon learning. Providing examples of good practice can reinforce the acquisition of skill.

RETENTION OF SKILLS

A major problem is that any newly-acquired skill tends to disappear if it is not used regularly. Exposure to clinical practice is unpredictable in many branches of medicine, and it may be many weeks or months before a doctor has to perform a particular procedure. Even if a doctor has mastered a technical skill during a 1- or 2-day course, this skill is likely to evaporate if not used regularly.

Ideally, doctors would attend regular refresher courses to keep all their skills updated. Pressures of work within the NHS make this an unrealistic goal, and individual or workplace-based training seems more likely to succeed. For this reason there is a need for structured progammes which can provide ongoing training instead of relying on a single training episode.

TRAINING COURSES

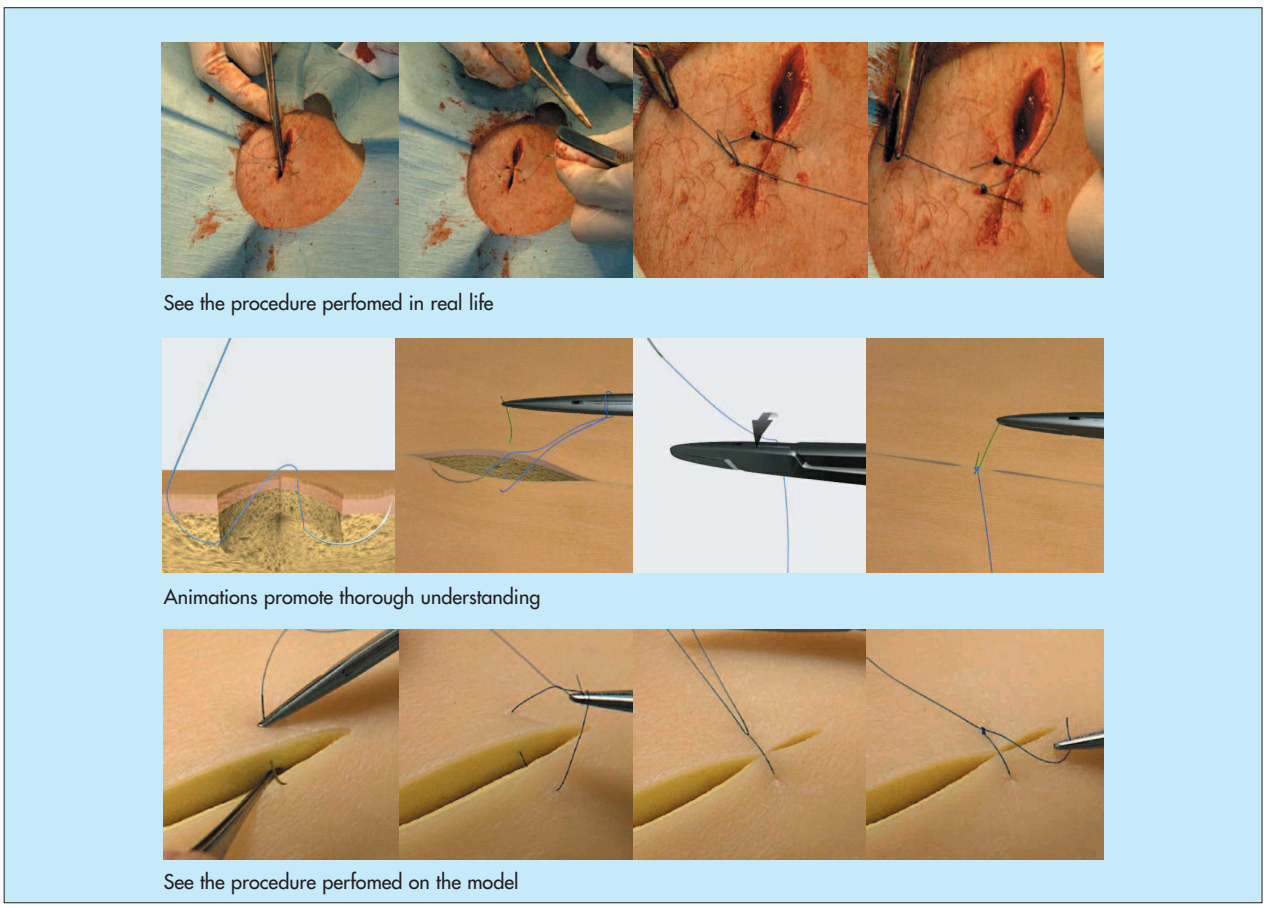
Skills training courses are now widely available. A range of levels is addressed, from junior undergraduates learning basic clinical skills to senior consultant surgeons perfecting new techniques.

Skills teaching requires a mixture of didactic provision of information and individual tuition. Computer-based multimedia offers an opportunity to design teaching material aimed at specific groups of learners. Computer-generated animated graphics can summarize the essence of a procedure or technique, while clinical videotape can demonstrate its application in real life (Kneebone and Schofield, 1998).

Having immediate access to a range of such visual material could be of great benefit to teachers. However, material must be structured so that it can be used effectively for teaching, and personal experience has convinced the author that multimedia packages designed for self-directed learning are seldom suitable for group teaching.

A promising recent development by the author and his colleagues is a multimedia resource designed specifically for group teaching of surgical skills (*Figure 1*). This provides the teacher with immediate access to a large number of high-impact visual sequences (computer-generated animated graphics, clinical video and demonstrations on simulated tissue models). The sequence in which these images are presented provides a supporting structure for inexperienced teachers, while those with more experience can ignore this underlying framework and pick out only the images they need for illustration.

Figure 1. A three-stage approach to learning a skill.



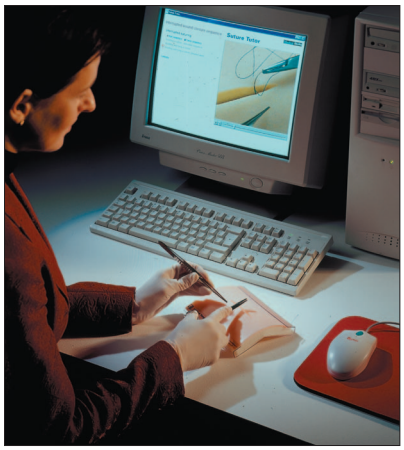


Figure 2. Practising on a model while using the computer.

Short video sequences of demonstrations on models allow the teacher to highlight technical points during workshops, without having to demonstrate procedures personally. This allows the teacher to concentrate on teaching, without being distracted by the need to perform. Teachers can therefore tailor their instruction to the requirements of individual learners, or present more general points to a whole group.

SELF-CONTAINED TRAINING PACKS

A complementary development by the author and colleagues is the concept of a self-contained practice pack for technical skills. This self-directed learning module can either be used alone, or in conjunction with the training module described above, as it uses similar visual resources.

This approach has been piloted for the techniques of wound closure. This deliberately addresses a limited range of skills, namely those needed for closing a straightforward skin wound with sutures. A skin pad and a set of instruments allow practice on a model, while an accompanying multimedia CD-ROM gives structured information about what to do and how to do it. Computer-generated animated graphics and clinical video sequences are supported by explanatory text for each technique, while expert demonstrations on simulated tissue show how to do the procedures (*Figure 2*).

The program is designed to meet the needs of a variety of learners, including medical students, junior doctors and others in related professions. It makes no assumptions about pre-existing knowledge or skill but sets out a logical approach to the subject, starting from first principles.

Training exercises allow a learner to move through the steps of each procedure at their own speed. Additional information about instruments and related techniques can be accessed rapidly if needed. An image bank of common errors allows learners to examine their own performance critically and correct any weaknesses in technique.

Because it is self-contained, this pack requires no facilities apart from access to a computer. It can be used at home, in the surgery or at a postgraduate centre. The structured exercises encourage learners to repeat each procedure as often as needed, and provide a means of experimenting with correct and incorrect techniques in privacy and without any risk of harm to patients. It is designed to be used as an adjunct to formal tuition and supervised clinical experience, not as a substitute.

A similar approach is now being adopted for a range of additional procedures. Some are especially relevant to primary care (e.g. ellipse excision of skin lesions, removal of cysts and lipomas, treatment of ingrowing toenails and a variety of dermatological techniques such as curettage and shave biopsy). Others are aimed at junior trainees in surgical specialties (e.g. bowel and vascular anastomosis).

Preliminary qualitative evaluation of this concept is encouraging, and shows it to be acceptable to learners and teachers. Work is in progress to explore it further. HM

KEY POINTS

- Training in basic surgical skills is widely perceived to be inadequate.
- Learning any skill requires sustained deliberate practice.
- Technical skills must be acquired within a context of knowledge and clinical judgment.
- Model-based skills training allows learners to develop core skills without jeopardising patient safety.
- The combination of multimedia and simulated tissue models can provide effective teaching.
- A self-directed learning pack allows learners to practice skills in private, according to individual need.

Conflict of interest: The self-directed learning program on wound closure described above is marketed by Medical Skills Ltd under the name Suture Tutor. The other programs are marketed by the same company. The author declares a financial interest as a member of Medical Skills Ltd, a company created to develop training solutions using multimedia and models.

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