

Teaching Surgical Skills: What Kind of Practice Makes Perfect?

A Randomized, Controlled Trial

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and Richard Reznick, MD, MEd, FRCSC, FACS

Objectives: Surgical skills laboratories have become an important venue for early skill acquisition. The principles that govern training in this novel educational environment remain largely unknown; the commonest method of training, especially for continuing medical education (CME), is a single multi-hour event. This study addresses the impact of an alternative method, where learning is distributed over a number of training sessions. The acquisition and transfer of a new skill to a life-like model is assessed.

Methods: Thirty-eight junior surgical residents, randomly assigned to either massed (1 day) or distributed (weekly) practice regimens, were taught a new skill (microvascular anastomosis). Each group spent the same amount of time in practice. Performance was assessed pretraining, immediately post-training, and 1 month post-training. The ultimate test of anastomotic skill was assessed with a transfer test to a live, anesthetized rat. Previously validated computer-based and expert-based outcome measures were used. In addition, clinically relevant outcomes were assessed.

Results: Both groups showed immediate improvement in performance, but the distributed group performed significantly better on the retention test in most outcome measures (time, number of hand movements, and expert global ratings; all *P* values <0.05). The distributed group also outperformed the massed group on the live rat anastomosis in all expert-based measures (global ratings, checklist score, final product analysis, competency for OR; all *P* values <0.05).

Conclusions: Our current model of training surgical skills using short courses (for both CME and structured residency curricula) may be suboptimal. Residents retain and transfer skills better if taught in a distributed manner. Despite the greater logistical challenge, we need to restructure training schedules to allow for distributed practice.

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Changes in the surgical training curriculum, precipitated by limitations to resident work hours,^{1,2} concerns over patient safety,^{3,4} and budgetary constraints in the operating room^{5,6} have compelled surgical educators to search for more effective and creative means of teaching surgical skills. Emerging technologies have also created a need for strategies to deliver technical education to surgeons already in practice. Consequently, laboratories dedicated to teaching technical aspects of surgical skill have become increasingly popular worldwide. These laboratories deploy an increasing array of training models, both low and high fidelity, many of which have been validated as effective teaching tools.^{7,8} Much work has been done on the development of performance metrics of assessment that can chart the progress through training regimens, demonstrate effects of intervention, and differentiate between varying levels of experience.^{9,10} Recently, there has been an important focus on ensuring that skills taught in laboratory environments can translate to the real world of human operations.^{11,12}

Despite the important work on model development, simulators, and assessment methodologies, there is needed effort in the realm of curricular development.¹³ The ways in which the training is delivered (how, what, when, and how often) are equally important. For example, in many programs, junior residents learn a particular skill 1 week and return the next week to learn a different skill, with very little opportunity structured within the curriculum to rehearse what has previously been taught. Likewise, many CME programs offer courses that are short and intensive (1-day or weekend), not allowing for rehearsal of skills after a period of rest (and forgetting) has elapsed. Commonly, there is a delay between the time the skill is learned in the laboratory and the time the skill is needed in the operating room. Performance may be adequate immediately following training, but how much is retained is uncertain. The ultimate value of skills courses should be measured not by performance immediately after training, but by performance after a time delay, preferably in a realistic setting.

Drawing upon the motor skill learning principle of massed versus distributed practice found in the domains of psychology and athletics, there is good evidence that practice interspersed with periods of rest (*distributed practice*), leads

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