Training of visuo-manual co-ordination during endoscopic tasks using ‘electromechanical’ and ‘Virtual Reality’ phantoms

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Introduction

Videoendoscopy is used in various disciplines like laparoscopy or urology. It spares the endoscopist much fatigue associated with traditional endoscopy, and reduces the need for the surgeon to take awkward positions during the work. However, videoendoscopy produces a new problem: it requires the endoscopist to look at a different position than where the actual operation is carried out. This forces him to learn transformations, which may compensate differences between visual information and hand movement (Gallagher et al., 1998). Learning such transformations may be a prerequisite for a safe and efficient performance of complex videoendoscopic tasks. The development of simulators (mannequins, electromechanical, virtual reality) seems to be of importance to cover the gap between theoretical learning and real practice (Allan & Tolley, 2001; Laguna et al., 2002; Michel et al., 2002). Specific training concepts, how a trainee can learn or train the execution of an endoscopic task most exactly, are not available. As alternatives for an optimal learning of complex tasks, in literature are proposed either blocked practice (i.e., each version of a task is practiced separately in separate blocks) or random practice (i.e., all versions of a task occur in a random order, Schmidt & Lee, 1999).

Questioning and Methodology

Two questions were investigated: i) Is blocked or random learning better for learning transformations? ii) Does Electromechanical (EM) or virtual reality (VR) phantom bring out better performance?

For this reason, an Electromechanical phantom (EM) and a Virtual reality phantom (VR) were developed, with which identical endoscopic tasks could be trained. Each phantom containing ten targets inside a 20 x 20 x 20 cm cubic box with an opening at the centre of its front for inserting the endoscope (figure 1). In both phantoms, the targets were located at ten spatial positions: five horizontal angles (left: angle 40° or 20°, centre: angle 0°, right: angle 20° or 40°) and two insertion depths (10 cm, 15 cm). Each target consisting of three concentric circles for measuring the accuracy. Both phantoms enabling a proprioceptive feedback, either by means of a spring on