



## Original Article

# Effects of Surgical Simulation on the Implementation of Laparoscopic Colorectal Procedures<sup>☆</sup>

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## A B S T R A C T

**Introduction:** Advanced laparoscopic surgery requires supplementary training outside the operating room. Clinical simulation with animal models or cadavers facilitates this learning. **Objective:** We measured the impact on clinical practice of a laparoscopic colorectal resection training programme based on surgical simulation.

**Materials and methods:** Between March 2007 and March 2012, 163 surgeons participated in 30 courses that lasted 4 days, of 35 h (18 h in the operating room, 12 h in animal models, and 4 h in seminars). In May 2012, participants were asked via an on-line survey about the degree of implementation of the techniques in their day-to-day work.

**Results:** Seventy surgeons (47%) from 60 different hospitals answered the survey. Average time elapsed after the course was 11.5 months (2–60 months). A total of 75% initiated or increased the number of surgeries performed after the training. The increase in practice was >10 cases/month in 19%, and <5 cases/month in 56% of surgeons. Thirty-eight percent of participants initiated this surgical approach.

**Conclusions:** Seventy-five percent of the surveyed surgeons increased the clinical implementation of a complicated surgical technique, such as laparoscopic colorectal surgery, after attending a training course based on clinical simulation.

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## Efecto de la simulación quirúrgica en la implementación clínica de procedimientos colorrectales laparoscópicos

## R E S U M E N

**Introducción:** La cirugía laparoscópica avanzada necesita complementar el aprendizaje fuera del quirófano. La simulación clínica con animales o cadáveres favorece este aprendizaje.

## Palabras clave:

Colorrectal

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Entrenamiento  
Simulación

**Objetivo:** Mostrar el grado de impacto en la práctica quirúrgica diaria en los cirujanos que realizaron un curso clínico-experimental de cirugía colorrectal laparoscópica.

**Material y método:** Entre marzo de 2007 y marzo de 2012, realizamos 30 cursos de 4 días de duración, durante 35 h (18 en quirófano, 12 en animales de experimentación y 4 en seminarios), en los que participaron 163 cirujanos. En mayo de 2012, vía online, se les remitió una encuesta con la finalidad de evaluar el impacto que este curso podía haber tenido en su práctica diaria de cirugía colorrectal laparoscópica.

**Resultados:** El número de encuestas contestadas fue de 70 (47%), que correspondían a cirujanos de 60 hospitales diferentes. El periodo medio tras el curso fue de 11,5 meses (2-60). El 75% de los cirujanos iniciaron o aumentaron el número de cirugías que realizan después del curso, siendo este aumento menor de 5 casos/mes en el 56% y mayor de 10 casos/mes en el 19%. El 38% iniciaron esta vía de abordaje.

**Conclusiones:** El 75% de los cirujanos encuestados aumentaron la implementación clínica de una técnica quirúrgica compleja como es la cirugía colorrectal por vía laparoscópica, después de realizar un curso de entrenamiento apoyado en simulación clínica.

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## Introduction

In recent years surgical simulation has been increasingly used in Spain in general surgical training as a learning tool to complement the traditional methods as it meets many of the needs arising in today's healthcare context.<sup>1,2</sup>

There are several factors which make surgical simulation widely accepted from the point of view of surgical technique: it promotes the integration of complex surgical knowledge and skills<sup>3</sup>; it improves the efficiency of movements, reduces the number of errors and the time taken to complete a task; it increases the extent to which learning is retained when compared with traditional teaching methods; it speeds up the learning curve; surgical skills are transferred to the care environment and it has been associated with reduced complications in patients.<sup>4</sup>

At present, most surgical teaching still involves learning from other more experienced surgeons acting as mentors. This training can be complemented using courses showing experts performing surgery on patients.<sup>5</sup> However, a growing number of publications describe the use of virtual reality simulation models,<sup>6</sup> on animals or cadavers,<sup>7</sup> as a valid training model for laparoscopic surgery. One determining factor in the choice of a particular training technique is its effect on the clinical implementation of new procedures. However, the publications which describe the training models seldom reflect the extent to which the different learning models are being implemented clinically.<sup>8</sup>

The objective of this publication is to verify that the surgeons undertaking training programmes based on surgical simulation of laparoscopic colorectal surgery are increasing the rate at which this surgical technique is being implemented in their patients.

## Materials and Methods

We present an observational and longitudinal study undertaken from March 2007 to March 2012, the object of which was to analyse the clinical impact that 30 training programmes might

have had for 163 surgeons. The programmes were based on surgical simulation of laparoscopic colorectal surgery performed in the Valdecilla University Hospital and in the experimental facilities of the Valdecilla virtual hospital.

These surgeons, from 86 different hospitals, were sent an on-line survey to measure the degree of impact on clinical practice of these techniques in their hospitals of origin after the course and to assess any difficulties. The questions they were asked included: their individual experience in laparoscopic colorectal surgery prior to the course; the number of colectomies in their department and the amount performed by laparoscopy; the extent of clinical implementation after the course expressed in number of cases/month; obstacles or difficulties in implementation ([Appendix A](#)).

The design of the course (35 h over 4 days) was divided into 3 parts with different content. The first involved 3 surgical sessions with 5 patients where an expert surgeon performed the laparoscopic surgical technique. After each intervention, the stages of the basic techniques were deconstructed and the expert analysed each with the course participants.

The second stage involved experimental operating theatres, over 3 days of 4 h each. On the first day the trainees performed intestinal anastomoses on pig entrails *ex vivo*, using an endotrainer, on an individual basis. Over the next 2 days, left and right colectomies were performed on live animals following the stages shown during the surgery on the patient. At the end of each of these sessions, a debriefing took place in order to think through and analyse the technical stages performed during each procedure.

The third stage was developed during the last day, and lasted 5 h, when the instructors and the trainees examined the action protocols pre- and post-surgery and the surgical details dealt with during the clinical sessions which were backed up with videos. The objective of all of this was to prepare an action protocol which could later be implemented in their hospitals.

The trainees were monitored by the same surgeons that had operated on the patients, both during the endotrainer training and during the colon resections performed on animals; so that each instructor worked with 2 trainees. Likewise, during the practice session a direct, objective,

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