

Digital 3-Dimensional Virtual Models in Colorectal Cancer and Its Application in Surgical Practice

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To the Editor:

Colorectal cancer is one of the most common pathologies in hospital surgical services, and surgery is at present the only curative treatment. This procedure includes the resection of the tumor and its lymphatic drainage. This type of surgery is associated with significant complications that increase patient morbidity and mortality due to multiple factors, including patient's clinical characteristics, operative procedure, and perioperative care.

Advances in cameras, screens, and dissection devices help improve operative procedures. However, these techniques are based on anatomical knowledge, and there is a huge variability in colon and rectum morphology and associated pathologies. For this reason, establishing a presurgical plan for patients reduces the occurrence of intraoperative adverse events and postoperative complications.

In recent years, the use of new technologies, such as 3-dimensional (3D) visualization or virtual reality, has helped surgeons establish a preoperative surgical plan for each surgery and patient. These advances are especially useful in minimally invasive colorectal surgery due to the variability in location, anatomical relationship to other organs, and vascular variants found in this type of procedures.

Our work seeks to build a digital 3D virtual model out of computed tomography (CT) scan images of colorectal cancer patients. Virtual models are obtained from preoperative CT scans of tumors located anywhere in the colon or rectum.¹ To be included, the tumor needs to show in a preoperative CT scan and surgery to be programmed by laparoscopic approach.

Computed tomography scans being used are General Electric Healthcare Revolution GSI and Siemens Somatom Perspective 64, and images are 3 mm in size. From DICOM files, colorectal digital images are reconstructed with a medical software application, and it is necessary that a radiologist indicates the exact image of the tumor in the CT scan. These images are marked section by section, drawing the contours of each organ to be included in the reconstruction.¹

When the tumor is located in the colon, this reconstruction provides a 3D image of the organ and the lesion.

Important references for surgical technique, such as the spleen in the left colon and the exact tumor location in the transverse colon, can also be added. If the cancer is in the rectum, references such as the seminal vesicles or the prostate can be added in order to determine lesion height and the best surgery in each case (Figure 1). Besides, vascular references can also be included in the models in order to help the surgeon decide on the length of the resected segment of the colon.²

Thus, a 3D reconstruction is obtained for each patient, which can enhance understanding of crucial anatomical details, such as a tumor's exact location and its relationship to other organs and structures in the patient; these details can be selectively displayed or hidden. These models can be turned into 3D in order to be able to appreciate the details on all sides of the reconstruction.

This information has significant applicability to clinical practice, as it allows surgeons to estimate colorectal anatomy, tumor size, and relationships, providing key landmarks to choose the most accurate surgery, the best trocar location, and a safer dissection, especially in those cases where tumor location can radically change the type of surgery used.^{3,4} This presurgical plan aims at avoiding intraoperative and postoperative complications and improving surgical outcomes, such as surgery duration and resectability of some lesions.

In conclusion, the preoperative CT scan colorectal image reconstruction can enhance the understanding of crucial anatomical details of colon and tumor locations and relationship of each patient, which can help choose the best surgical option in each case and improve safety in colorectal surgery.

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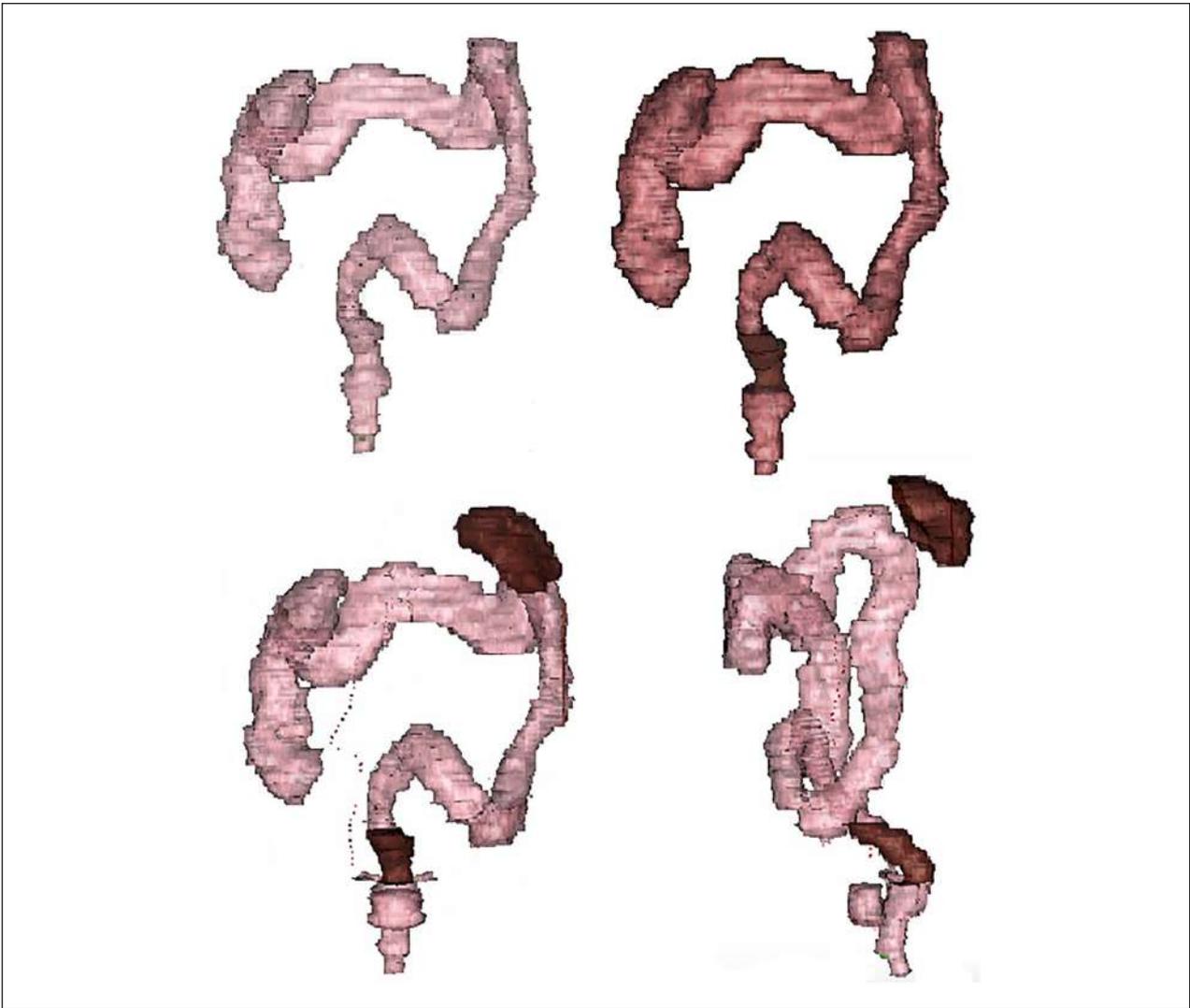


Figure 1. Rectum neoplasm model with spleen, seminal vesicles, and prostate reconstruction.

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Author Contributions

Study concept and design: Natalia Pérez-Serrano and José Fernando Trebolle.

Acquisition of data: Natalia Pérez-Serrano.

Analysis and interpretation: Natalia Pérez-Serrano.

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