

3 Ergonomics of Endoscopic Surgery

STEVEN Z. RUBIN AND MARCOS BETTOLLI

3.1 Introduction

3.1.1 Indications for Endoscopic Surgery

There must be a demonstrable advantage to the patient (i.e., rapid return to normal function; cosmetic advantage; decreased complications).

3.1.2 Requirement for Procedures

Endoscopic surgery requires advanced surgical and nursing training in the purchase and use of the equipment and instrumentation.

3.1.3 Complications

Most are related to equipment misuse/failure and improper surgical access.

3.3 Operating Room Requirements

1. Adequate room size.
2. Room/endoscopic surgery light sources.
3. Multiple adjustable and mobile monitors.
4. Carbon dioxide insufflation.
5. Endoscopic suction and irrigation.
6. Electrosurgery, laser, harmonic scalpel.
7. Radiological imaging.
8. Anesthetic equipment.
9. Specialized operating table.

3.2 Definition and Aim

Ergonomics is the application of scientific information to the design of objects, systems, and the environment for human use (International Ergonomic Association). The aim of ergonomics in endoscopic surgery is to improve human performance, decrease surgical fatigue, and minimize the dangers and disadvantages. Thus, operating room design requires input from an ergonomic expert, and surgeons and nurses trained in endoscopic surgery.

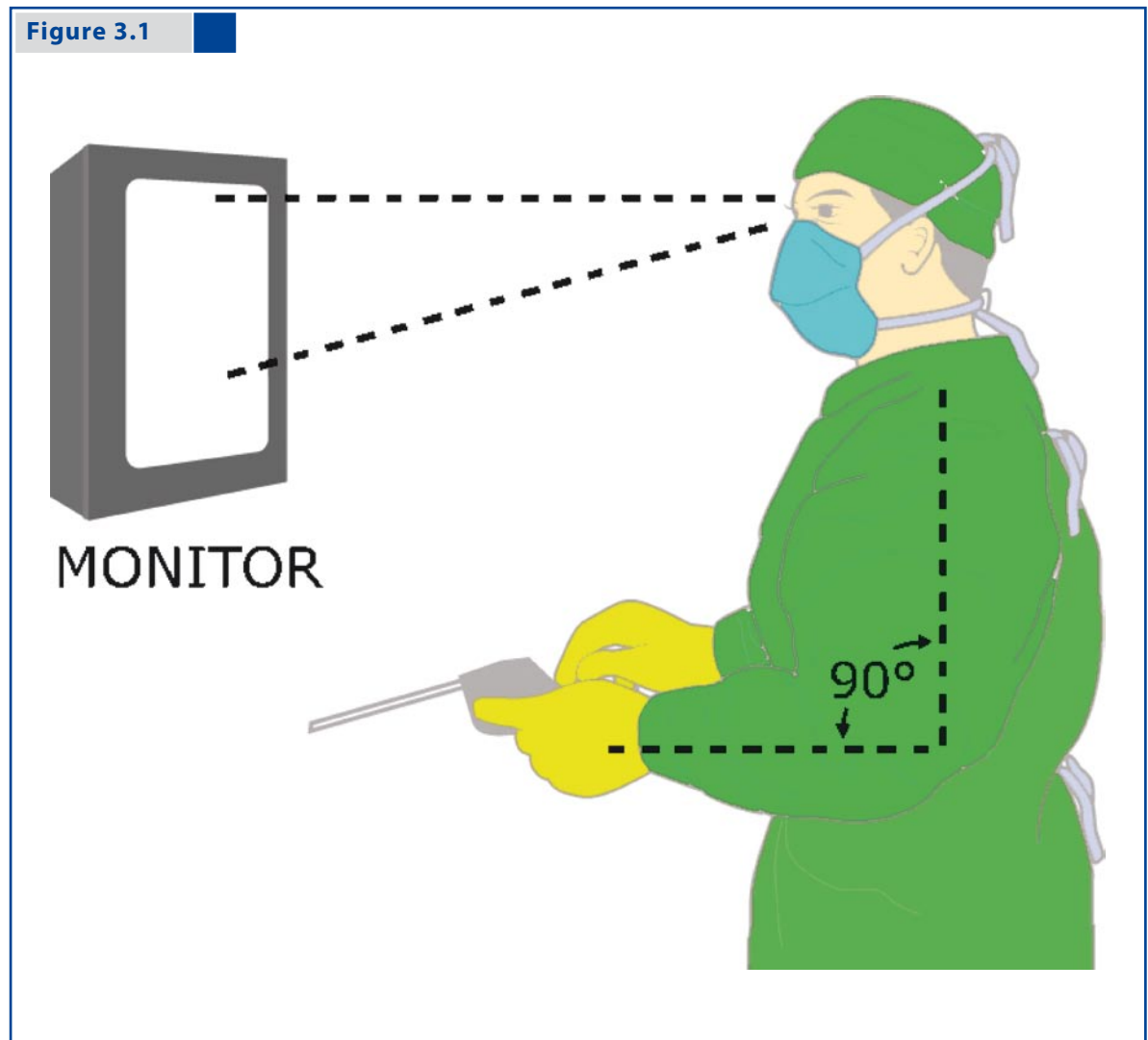
3.4 Manpower Requirements

1. Surgeon trained in endoscopic surgery.
2. Surgical assistant experienced in use of the camera.
3. Second surgical assistant.
4. Nurses trained in endoscopic surgery.
5. Anesthetist trained in endoscopic surgery.

3.5 Technical Requirements

1. Functional instruments compatible with the size of the patient and the surgeon.
2. A monitor directly facing the surgeon in a line so that the level of vision is neutral or with a slight inclination of cervical spine (Fig. 1).
3. Surgeon, assistant, and nurse on same side of the patient.
4. Triangulation of the ports with the camera centrally placed.
5. Mechanized assistance for camera and retraction.
6. Needle driver port in the same axis (0°) as the suture line.

Figure 3.1



Line of vision

3.6 Robotics

The advantages of robotic systems are many since they overcome many of the obstacles of endoscopic surgery. They increase dexterity, restore proper hand-eye coordination and an ergonomic position, and improve visualization. In addition, these systems make possible surgeries that were previously technically difficult. However, at present there is no evidence-based ergonomic advantage for robotics in pediatric endoscopic surgery.

3.8 The Future

1. Improved ergonomic operating room and equipment design with integrated systems under the control of the operating surgeon.
2. The development of an endoscopic pointer using ultrasound, computed tomography, and magnetic resonance imaging to identify vessels and anatomical relationships.
3. Instruments that intraoperatively adjust to the surgeon's hand size and the size of the patient.

3.7 Improvement of Team Performance

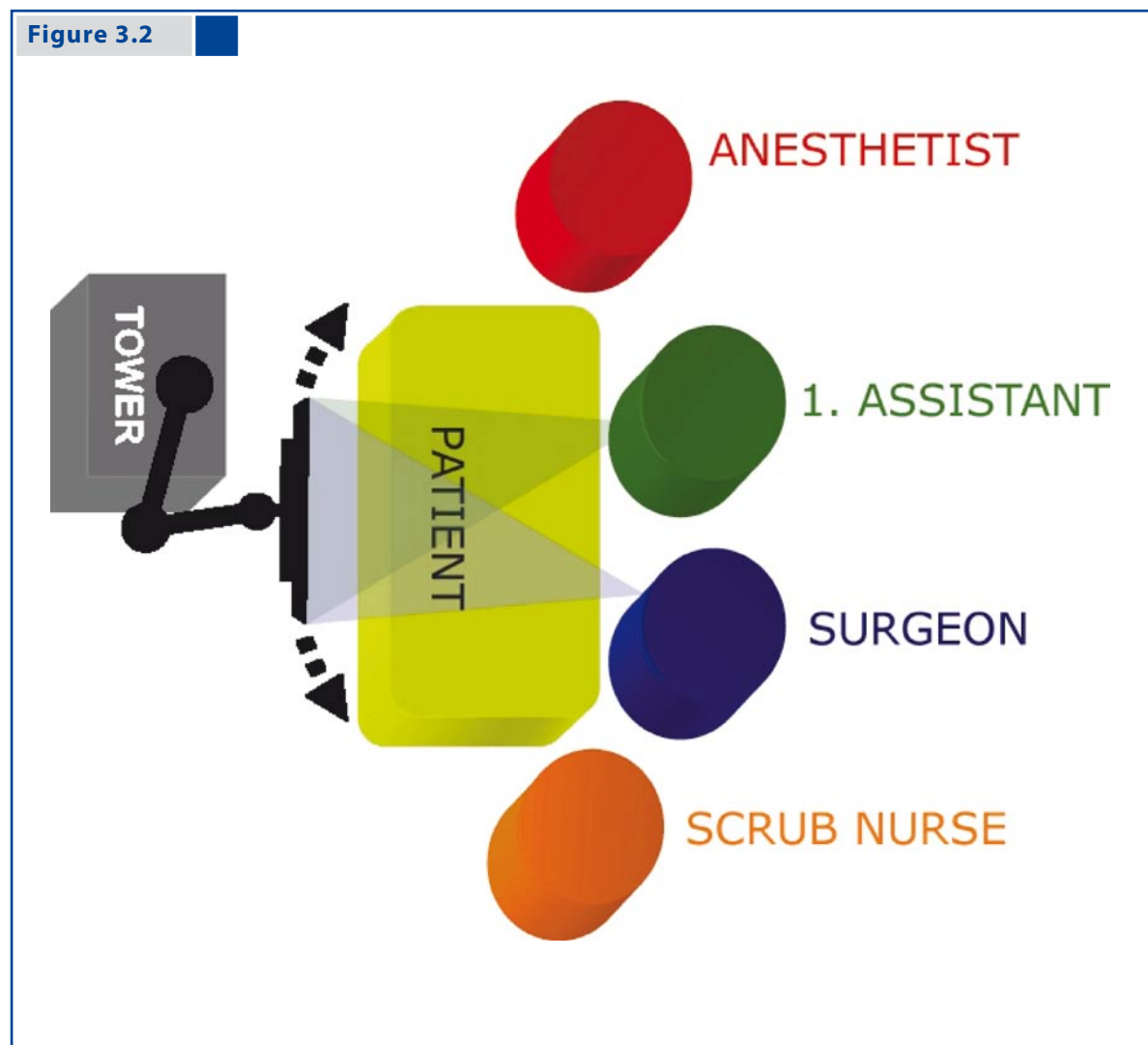
1. Using training courses and human reliability analysis.
2. Using a surgical team; this is better than one bi-manual surgeon.
3. The surgeon is preferably seated.
4. Using ultrasound, computed tomography, and magnetic resonance imaging to display vessels, nerves and tumors.
5. Team review of advanced procedures both pre- and postoperatively.
6. Improve procedure visualization using overhead illumination, gravity, and optimizing camera position.

3.9 Operating Staff Positions and Ergonomics

3.9.1 Single-Monitor Option

If a single monitor or flat screen panel is used, it should be positioned suitably to allow sufficient vision to the operating team (Fig. 2). This option is practical when the entire operating team stands on one side.

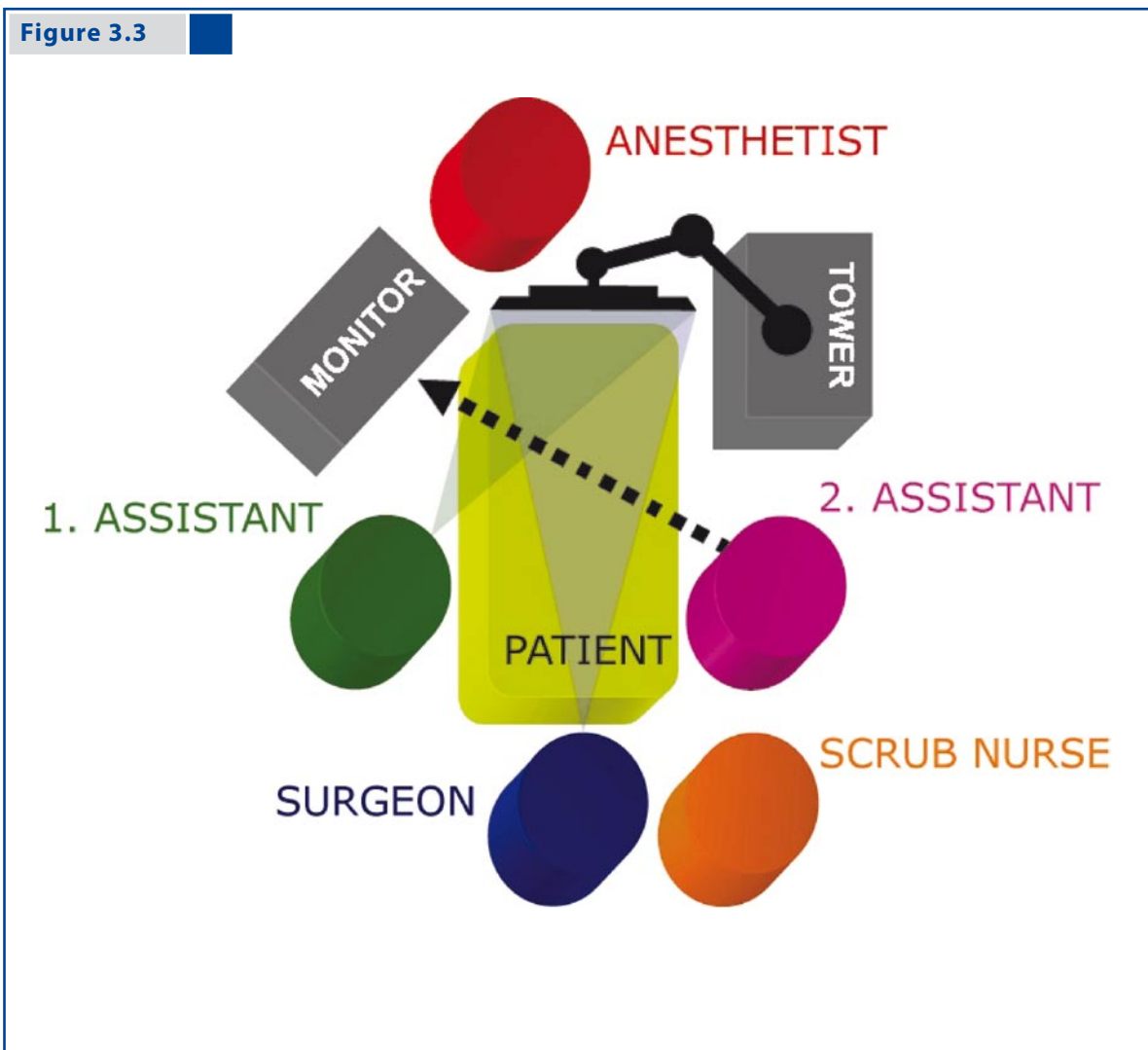
Figure 3.2



Single-monitor option

3.9.2 Dual-Monitor Option

If the operating team is dispersed around the operating table it is advisable to have two monitors so that the entire team has visible access irrespective of their position (Fig. 3).

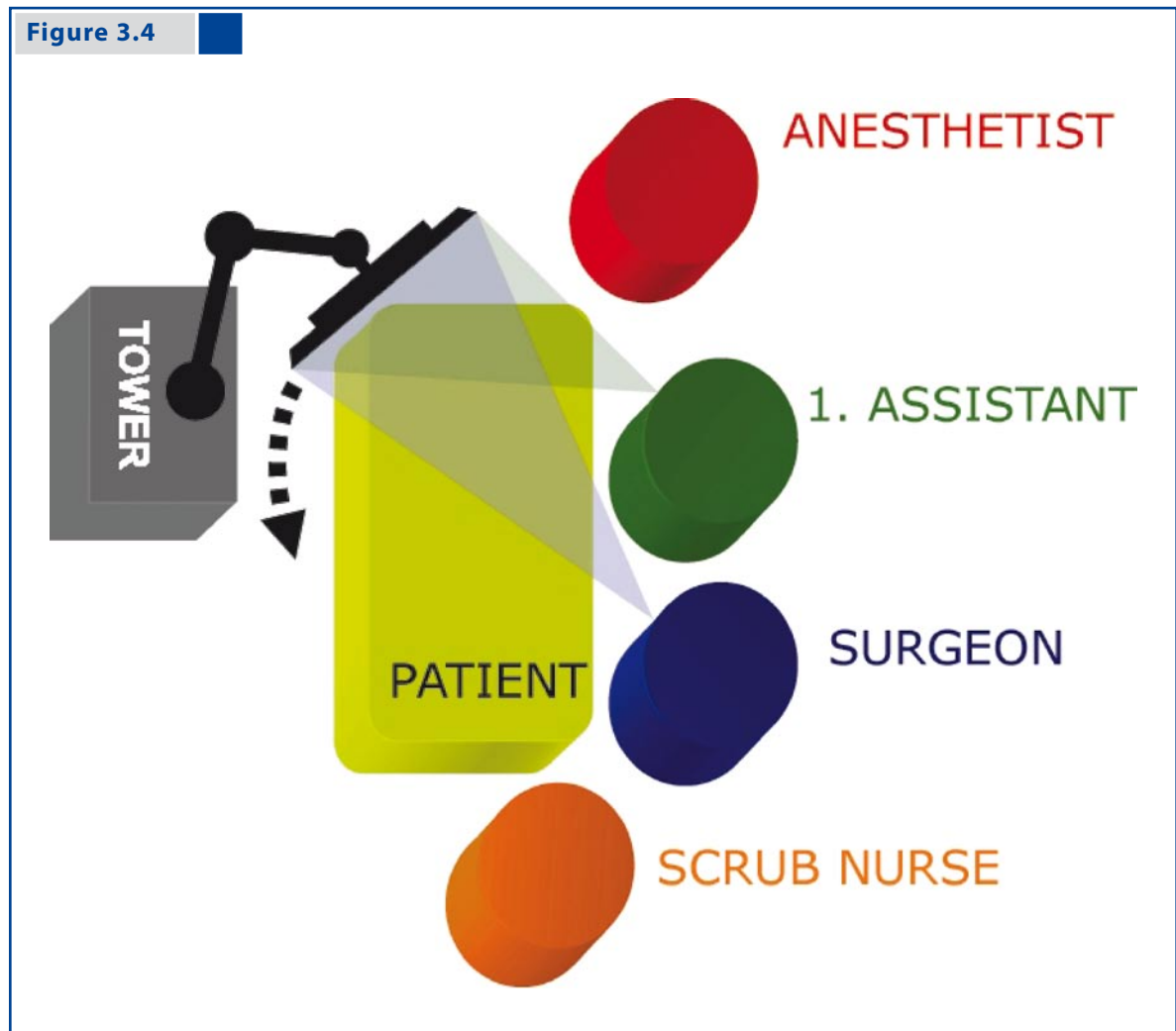


Dual-monitor option

3.9.3 Ventilator vs. Monitor Placement

It is often difficult to position the tower toward the head of the patient since this place is occupied by

the anesthetist and the ventilation equipment. A swivel flat screen is helpful to overcome this problem (Fig. 4).



Ventilator vs. monitor placement

Recommended Literature

1. Catchpole K, Mishra A, Handa A, McCulloch P (2008) Teamwork and error in the operation room: analysis of skills and roles. *Ann Surg* 247:699–706
2. Hanna GB (1999) Ergonomics of task performance in endoscopic surgery. In: Bax NMA, Georgeson KE, Najmaldin A, Valla J-S (eds) *Endoscopic Surgery in Children*. Springer-Verlag, Berlin, pp 37–47
3. Zehetner J, Kaltenbacher A, Wayand W, Shamiyeh A (2006) Screen height as an ergonomic factor in laparoscopic surgery. *Surg Endosc* 20:139–141