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Improvement of the ergonomic situation in the integrated operating room for laparoscopic operations

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Abstract. The aim of our work is to reduce the stress and strain for the medical staff and simultaneously to increase the efficiency and safety of an integrated operating room system (SIOS) by an ergonomic redesign of the system. SIOS system is a central control system developed by Siemens Medical Solutions mainly used for laparoscopic operations. This new integrated system has been created to improve the efficiency in operating rooms (ORs). The interactive manner of control of nearly all parameters, like the position of the OR table or the intensity of the light, is the main difference of the integrated OR system SIOS compared with conventional operating rooms. However, considering the postures of the doctors and the nurse, the operating room is still a very uncomfortable place of work. To make an ergonomic approach, many factors like human capabilities, functions, anthropometrics, psychological, and physical ones have been taken into account. We performed an ergonomic analysis and propose a new ergonomic redesign.

Keywords: Ergonomics; CAD; Computer simulation; Operating room; Laparoscopic operation

1. Introduction

Minimally invasive surgery, or minor access surgery, is a new surgical approach avoiding large incisions for intrabdominal operations as required in conventional (open) surgery.

This is achieved by introducing three or more trocars (ports) into the abdominal cavity which permit the introduction of a camera-monitored telescope and two or more fine instruments to perform the operation in a similar manner as, formal, in open surgery. This new approach requires, in comparison to open surgery, an additional spectrum of devices and technical support (lights sources, camera, control unit, insulator, video screens, etc).

In standard operating rooms (ORs), this additional equipment is positioned upon special trolleys. A top of these trolleys, the monitor/video screens is positioned. In most of the

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cases, it is not easy to find an "ideal" position for the trolley/monitor. A compromise between the 'ideal' position and the available space is inevitable [1–3].

2. Methods

In the first step, the ergonomic evaluation is broken down into its individual components which are characterized and analyzed. In our case, in five parts:

- The position and height of the monitors
- The posture of the surgeon
- The height of the operating table
- The posture of the nurse
- The height of the mayo stand (tables with the instruments).

Various scientific methods are available for such an ergonomic evaluation. The analysis of "the operating room" leads to a computer simulation approach. A simulator is used for evaluating and testing new design approaches. The simulator is composed from two systems, CATIA (www.catia.com) and RAMSIS [4,5]. CATIA is a CAD/CAM system in which the operating room is designed. RAMSIS is a simulation program in which 3D human models are created. This human model consists of an external skin model that gives it a realistic appearance and an internal skeleton model. The internal model fulfils the function of a framework and is simultaneously the carrier of the kinematical model. Hence, the internal

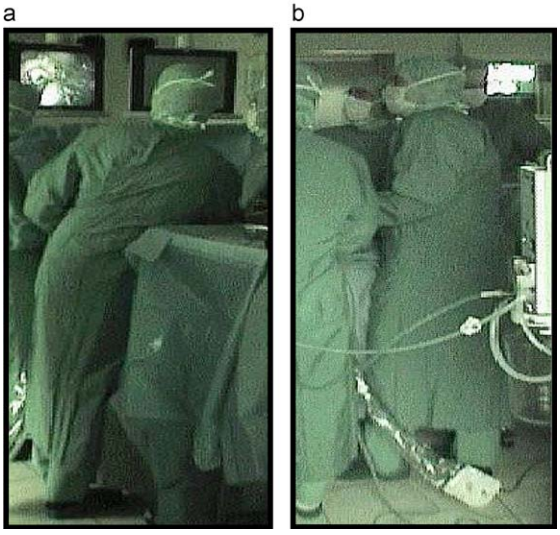

Fig. 1. Always pairs of pictures, simultaneously done from two different viewpoints were produced. Using the similar recordings of the calibrating body as a referral point, the digitalized pictures were analysed with the software PCMAN, proven to accurately measure the rotation, lateral and anteroposterior movements of joints and parts of the body. It is obvious that the postures of the surgeon are very uncomfortable. These photos were taken in order to make the ergonomic posture analysis.