



Ergonomics for the Surgeon

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Mini Review

Volume 6 Issue 2

Received Date: June 28, 2022

Published Date: July 15, 2022

DOI: 10.23880/ijst-16000168

Abstract

As a surgeon, few of us know much about ergonomics. However, all of us use ergonomics by instinct. How is that then? When we try to put everything at the “right” place in a surgical field, position the patient in a way that makes working easier for us, and perform fine maneuvers with our instruments in deep cavities with limited space we are using ergonomics; or trying to be ergonomic. Ergonomics is a rapidly growing science and is an essential part in every industrial product; be it the handle of a laparoscopic tool or a sophisticated surgical robot. We should feedback the Industry about what is more ergonomic for us, or what we “expect” from a product. If such a mutual communication develops, then we will be more satisfied by technical innovations in instruments. Ergonomics also applies to technical capabilities of humans; what makes some one better than others at handwork. Generally, this is the matter of inherent talent, which is diverse. However, all of surgeons need to be best at handwork during surgery. This is why we should learn more about ergonomics.

Keywords: Ergonomics; Surgery; Laparoscopic Tool; Cavities

Introduction

What is Ergonomics? There are many definitions for Ergonomics. An applied science which designs and arranges things so that the user and object interact most efficiently and safely; The study of how people work in their environment; The study of how humans interact with manmade objects; and many other similar ones. Ergonomics is a Greek word meaning natural laws of work. I would like to define ergonomics as the science of design and setting of products to optimize them to natural laws of human work and nature. In simple words, everything in the right way and the right place. It can be claimed that, there is no single right way and right place suitable for everybody. This is correct and it is the reason for the extension of Ergonomics definition; i.e. Human characteristics, such as height, weight, and proportions are considered, as well as information about human hearing, vision, tactile sensation, posture, and so on.

In fact, ergonomics is an active process trying to personalize the right way - the right place, and keep it in a steady state. Circumstances vary continuously as well as human physical status, so ergonomic solutions should have real time flexibility. As described by Encarta Dictionary: the study of how a workplace and the equipment used there can best be designed for comfort, efficiency, safety, and productivity.

Now it is clear that why Ergonomics is important for a surgeon and how it is able to promote the outcome of surgery. Generally speaking, it seems that ergonomics is not a major issue for surgeons. This may be due to unawareness of its important role. Human body has great physical capabilities; including flexibility, tolerance, and durability. Surgeons can perform delicate tasks for hours while standing in different complex bended, twisted, and unbalanced postures. Surgical trainees are trained in this context and follow the same principals in their own career. A surgeon can execute

sophisticated surgical procedures in astounding postures over hours. This leads to minor physical injuries which accumulate into occupational musculoskeletal injuries. Better ergonomics can reduce energy expenditure and decrease the loss of capacitance; leading to better efficiency and outcome. Advent of minimally invasive laparoscopic surgery brought up novel challenges for the surgical community. New rules had to be established. Laparoscopic surgery imposed not only new physical ergonomic challenges, but also significant mental complexities to overcome. Limited freedom of movement, indirect visualization of surgical field, and two-dimensional view of three-dimensional objects, are only a few mental ergonomics challenges faced by the surgeon during laparoscopic surgery [1,2].

Bending, twisting, and tilting do not help the surgeon to get a better view during laparoscopic surgery; and there is no generous retraction by retractors or hands, either. To get a better view the surgeon has to utilize patient positioning, taking advantage from the interaction between gravity and natural fixations of visceral organs. Perhaps, serious exploitation of ergonomics in surgery was triggered with the demand for more advanced laparoscopic procedures, i.e. how can limited access and simple tools be used most efficiently for a complex laparoscopic surgery. Surgeons started taking advantage of anatomic nature and specs of visceral organs, positioning of the operating table, and rotational maneuver of angled tip camera to provide the best exposure. Laparoscopic procedures carry significant limitations compared to open surgery. Laparoscopic ports are fixed access points. Instruments are of small size and of much less diversity compared to open surgery. They are basically of the same design as the open surgical tools, but they have not reached their maximum functional maturity. Design of the instrument handle, instrument tip, position of the operating table, position of the monitor and foot pedals, tray cart place and height, place of the laparoscopy tower, locations of the port sites, surgical team arrangement around the patient, and coordination of movements between the surgeon and the cameraman are a couple ergonomic issues to be considered. Publication on ergonomics, considering minimally invasive laparoscopic surgery, started to appear near the turn of century [3].

After near 2 decades the problem of insufficient application of ergonomics by surgeons still exists [4]. Increasing complexity of minimally invasive laparoscopic surgeries leads to more musculoskeletal strain. At the same time, ergonomic developments are increasingly implemented into laparoscopic surgery. However, there is still no significant difference in localizations and frequency of musculoskeletal complaints, or work leave between surgeons practicing open vs. minimally invasive laparoscopic surgery [4]. Evidence show that we are yet far from ergonomic surgeons and

operating room [5,6]. Some studies show that work related musculoskeletal strain and injuries may be more common in minimally invasive surgery compared to open surgery, 73-100% vs. 66-94% [7]. Perhaps the long duration of static posture during laparoscopic surgery, associated with muscle tension, further contributes to musculoskeletal disorders [2]. Although static posture in laparoscopic surgery is a major contributing factor for musculoskeletal strain, there are other factors as well. Novice laparoscopic surgeons usually experience pain in hands, wrists, and shoulders. These pains can be caused by muscular over-contractions related to ergonomic breaks.

They may hold shoulders up because the level of operating table is high. Laparoscopic instrument handle may be grabbed and squeezed forcefully because of inappropriate design, function, or suboptimal port site selection. A literature review showed that work-related musculoskeletal symptoms is more common among all groups of surgeons performing minimally invasive surgery compared to those performing open surgical procedures [8]. While another review reported that generalized pain was noted in 69% of surgeons practicing minimally invasive surgery and 60% of surgeons performing open procedures; these figures were not statistically different [6]. One cohort study reported musculoskeletal pain in up to 70% of General Surgeons practicing open surgery [9]. The common finding of all studies is that work related musculoskeletal complaints are caused by under-utilization of ergonomic principals. The flaws of ergonomics seem to be not much different in laparoscopic vs. open surgery. But the limitations imposed by laparoscopic surgery paved the path to revealing the critical importance of ergonomics to the surgeon. Design and manufacture of instruments and hardware used in operating room is upon the industry. But industrial designer needs to know the details of problem and the requirements of the end user.

Therefore, a constant mutual communication should be established between the surgeon and the industry. This inter-relationship can lead to a real time promotion of ergonomics in surgical field. But this is not enough, even with optimal ergonomic hardware, it is the user who makes the difference. In fact, looked at from the ergonomic point of view most operations are, at first sight, a mess [10]. Presumably, we need constant ergonomic advice in the operating room. It can be said that every operation is a unique ergonomic task. Similar operations in the same operating room by the same surgeon is different from patient to patient. Surgeons manage these apparently similar ergonomic tasks to various extents; and this is a determinant of their performance and final outcome. The process of ergonomic management in those who have not studied ergonomics is based on inherent talent; perhaps various perceptions of spatial

geometrics is one influential factor. This is why surgeons are different in performing technically difficult operations, especially during minimally invasive laparoscopic surgery. Everyone working in the operating room should receive training on ergonomics. Surgeons are on the top of the list because they are responsible for the patient and the final outcome. Ergonomics should be introduced into educational curriculum of surgical resident training, medical students, and all the medical staff to some extent, specially those working in the operating room. It should be included in continuous medical education programs, as well. These proceedings will presumably promote the level of patient care and outcome, decrease work related disorders in health care professionals, and improve the cost benefit ratio in surgical care.

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