Understanding Ergonomics in LAPAROSCOPIC SURGERY

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In the wake of all advances, come the drawbacks. Laparoscopy is no exception. The drawbacks are majorly twofold. In the first scenario, the surgeon experiences the ill effects from the surgery, and secondly, the patient is the victim. This statement might seem superficial and poorly reflective in the first glance but it answers a much deeper question. There have been multiple reports of carpal tunnel syndrome, eyestrain and cervical spondylosis among unsuspecting surgeons performing multiple laparoscopic procedures in high-volume centres. Reports of thenar neuropathy have arisen due to use of awkward thumb grips in case of laparoscopic pistol-grip instruments.

In the first decade after the advent of laparoscopy, patients too have been found to be experiencing a lot of inconvenience with greater post-operative pain at port sites and due to other complications of the procedure in some cases. The mistakes leading to these poor outcomes seem to be completely avoidable with use of simple application of understanding of the physics and functioning of the whole event.

What is Ergonomics?

The term ergonomics is derived from the Greek words "ergon" meaning work and "nomos" meaning natural laws or arrangement. Ergonomics is "the scientific study of people at work, in terms of equipment design, workplace layout, the working environment, safety, productivity, and training". Ergonomics is based on anatomy, physiology, psychology, and engineering, combined in a systems approach.

Ergonomics and Laparoscopic Surgery

In open surgery, we look at and touch the patient's tissues directly using our hands or relatively simple instruments. In this situation, our senses of vision, touch, and position are working under normal conditions and with a large performance reserve so that standard surgical instruments, although not perfect, serve us well. During laparoscopic surgery, the situation is very different. The surgeon indirectly views the operative field and can only touch the intra-abdominal tissues with long instruments via ports that are in fixed positions. In laparotomy surgeons hand works in the area where he sees. But in laparoscopy, surgeon sees in front but works below, so a good hand eye co-ordination is needed. Our senses are now working much harder to achieve the same goals. The proper design of the instruments and the layout of the operating room now become critical to avoid fatigue and human errors. In other words, because simple tasks are more stressful and fatiguing during laparoscopic surgery, we have less physical and mental reserve to compensate for the poor design of instruments or the poor layout of the operating room environment (Figure 1). This is why ergonomics is important.

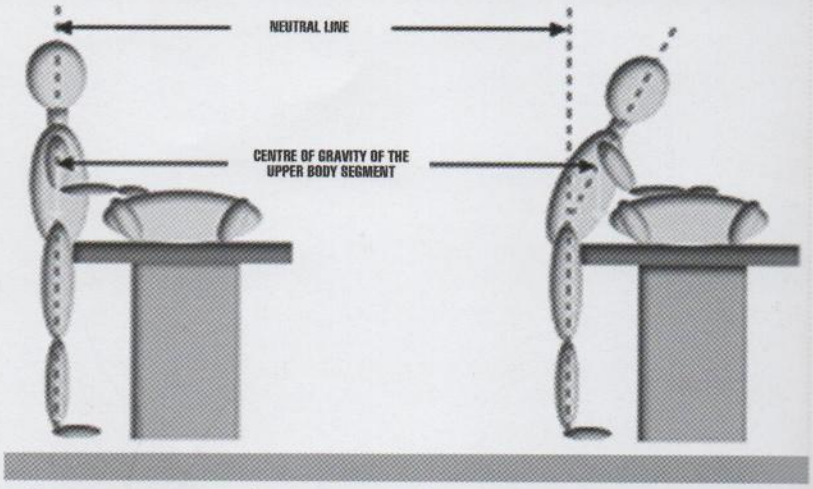
Critical Ergonomic Adjustments for Laparoscopic Surgery

The goal of proper posture is comfort, efficiency of movement, and minimization of the risk of musculoskeletal injuries to the operator. The surgeon's neck and back should be maintained in a comfortable and upright position facing forward.

During laparoscopic surgery, the ability to achieve this ideal posture is determined by:

1. The height of the operating room table
2. The position of the visual display (e.g., monitor)
3. Foot pedal locations
4. The selection of hand instruments

Although posture tends to be straighter in laparoscopic surgery (because the surgeon no longer has to bend and twist to look directly inside the patient), more than 15% of surgeons still report frequent back pain and stiffness following laparoscopic operations. These symptoms are likely due to the adoption of a more static posture (standing stiffly without moving),which is the result of increased concentration and the frequent need to look in one direction at the monitor while manipulating instruments or foot pedals in another direction.



Although individual adjustment in the layout of the operating room (patient and monitor position) can decrease this problem, it is always beneficial to periodically relax your mind and body, move around, look away from the monitor, and let go of the instruments. We unconsciously take these "minibreaks" during open surgery but often forget them during laparoscopic operations, which are more "intense."

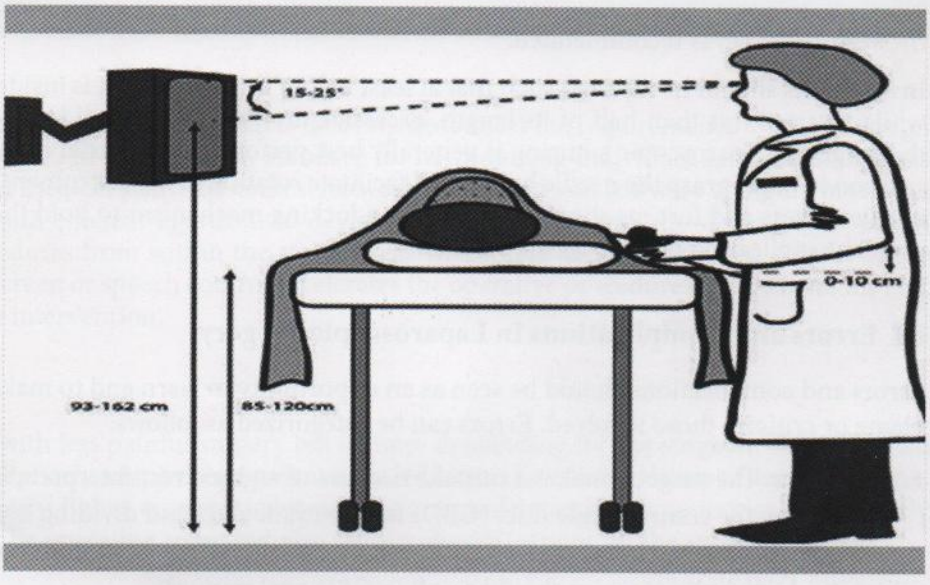
Operating Table Height

Ergonomically, the angle between the lower and upper arm should be between 90° and 120° when performing manual work. The operating table should be elevated or lowered such that the surgeon will be able to work within this ideal "window."For laparoscopic operations, the table's height should be adjusted so that laparoscopic instrument handles (after the instruments have been inserted into the ports) are roughly at, or slightly below, the level of the surgeon's elbows.Because laparoscopic instruments are much longer than their open counterparts, this requires lowering the table substantially. This may be difficult in some cases, and surgeon many need to stand on one or more lifts to achieve the proper table height.

Foot pedals

Foot pedals, which are often poorly positioned, demand awkward and unnatural postures and should be avoided in favor of hand controls when possible. Pedals should be placed near the foot and aligned in the same direction as the instruments, toward the target quadrant and the principal laparoscopic monitor. Such positioning will permit the surgeon to activate the pedal without twisting their body or leg. If the surgeon is standing on a lifting platform, the pedal must be placed at the same level off the ground. A pedal with a built-in foot rest is preferable so the surgeon does not have to hold their foot in the air or move it back and forth on the floor. If there are two pedals (for different devices), the surgeon must be careful not to confuse them in the darkness.

Vertical Positioning of Video Monitor



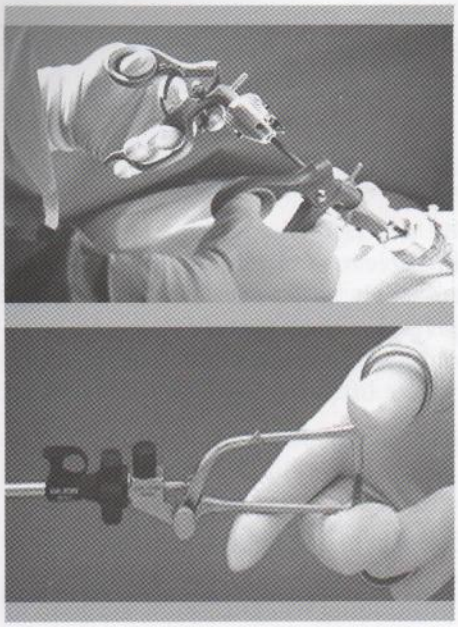
Because the surgeon views the surgical field through a visual display (e.g., video monitor) for lengthy periods during laparoscopic surgery, the position of the video monitor will affect neck and back posture. The display should be placed directly in front of the surgeon, 15°–40° below eye level for maximum comfort. Although standard video monitors still provide the best picture quality ,the quality of the image of flat panel screens, displays suspended from booms, and head-mounted displays is improving. Video display devices that are mounted on flexible booms allow the surgeon to alter the vertical position of the monitor to obtain the ideal angle between eye level and the monitor.

Choosing Laparoscopic Instruments

No single laparoscopic instrument design is substantially superior to others, so each surgeon needs to choose the design(s) that best achieves the following goals:

a. Enables the surgeon to keep both wrists in a neutral (unbent) position
b. Permits the surgeon to keep both arms at the sides of their body
c. Avoids pressure points on the hands
d. Allows the surgeon to apply force with a power grip (hammer or gun- style) hand position
e. Allows fine manipulation with a precision grip (pencil or forceps- style) hand position

Most laparoscopic instruments are designed with either a pistol grip-type handle or an axial (in-line) handle. The pistol grip allows the hand to remain at an angle to the instrument shaft and can lessen the ulnar deviation needed to use the axial handles. However, the axial handles permit the use of a fine grasp and rotation of the instrument in the hand that can be useful in fine manipulation and suturing.



The most important features to look for in laparoscopic instruments are these:

- Instrument handles that are smooth and broad surfaced to avoid pressure points and finger entrapment
- An internal mechanism that is smooth, precise, and allows good tactile feedback from the tip of the instrument to the handle
- Easy and intuitive access for the fingers to any additional controls that govern shaft rotation, jaw-locking, or electro-cautery or suction activation
- Sturdy insulation of the instrument shaft all the way to the base of the jaws to avoid stray electro-cautery injury during use
- An electro-cautery connector pin that keeps the electro-cautery cable out of the way of the surgeon's hand during use of the instrument
- Instruments that require substantial force to use (staplers, clip appliers, heavy graspers) should have a broad and smooth pistol-type hand that permits the surgeon to use a power-grasp hand position

Laparoscopic Surgical Technique

The location of the access ports is critical because they determine the reach and the working angle of the instruments passed through them. A manipulation angle range of 45°–75° (in the horizontal plane, the acceptable range of angles between the instruments inserted through the different ports) with equal azimuth angles (the elevation angle range in the vertical plane) is recommended.

Instruments should be inserted such that at least half of the instrument is inside the patient. If the instrument is utilized while inserted less than half of its length, excessive motion at the shoulder will be required, which is likely to fatigue the surgeon. Laparoscopic suturing is generally best performed with axial (in-line) instruments because they allow the surgeon to finely grasp the needle holder and facilitate rotation of the instrument with simple wrist motions. Laparoscopic needle drivers and forceps should incorporate a locking mechanism to hold the needle, thus obviating the need for the constant application of force by the surgeon.

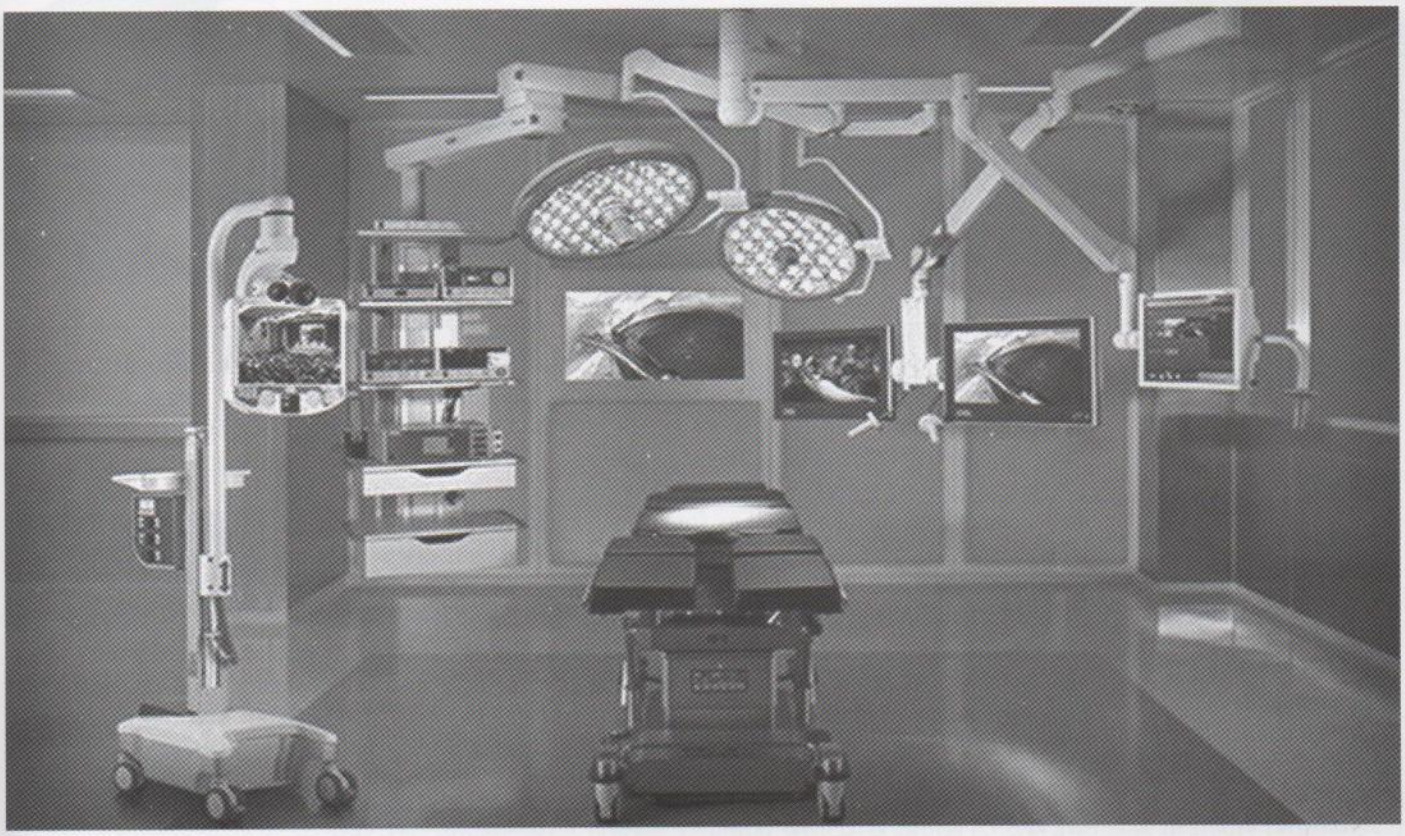
Errors and Complications in Laparoscopic Surgery

Errors and complications should be seen as an opportunity to learn and to make positive changes, and not used to blame or criticize those involved. Errors can be categorized as follows:

1. ***Mistakes***: The surgeon makes a mistake because of an incorrect interpretation of the anatomy or situation [e.g., mistaking the common bile duct (CBD) for the cystic duct and dividing it]. Similarly, the overzealous application of a "rule" that may be inappropriate in certain situations may lead to an error (e.g., CBD filling defects found on cystic duct cholangiogram should result in CBD exploration).
2. ***Slips:*** The surgeon makes the right decision but carries out the wrong action (e.g., presses the "cut" pedal instead of the "coagulation" pedal on the electrocautery).
3. ***Lapses:*** The Surgeon forgets to perform a procedure or a specific step in a procedure (e.g., forgets to check the integrity of a colonic anastomosis using air insufflation before closing).

We can avoid common slips and mistakes in laparoscopic surgery by;

- Ensuring that all operating room personal obtain adequate training.
- Striving to be in good physical and mental condition before surgery.
- Positioning all the equipment and instruments in a comfortable, efficient, and ergonomic manner.
- Maintaining a clear view of the operative field and instruments at all times.
- Converting to open surgery if the exposure is poor or the potential for complications seems higher than usual



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Conclusion

Laparoscopic surgery provides patients with less painful surgery but is more demanding for the surgeon. The increased technological complexity and sometimes poorly adapted equipment have led to increased complaints of surgeon fatigue and discomfort during laparoscopic surgery. Better ergonomic integration and understanding ergonomics can not only make the life of surgeon comfortable in the operating room but also reduce physical strains on the surgeon.

Most common reason for the inability of ergonomics to be applied optimally in the field of laparoscopy could be enumerated as the lack of complete awareness among surgeons, communication gap between the practitioners of laparoscopy and the designers of the instruments, inadequate knowledge of the potential problems for the users in the instruments created by the designers and the contradictory expert advice which reduces the credibility of ergonomics as a science.

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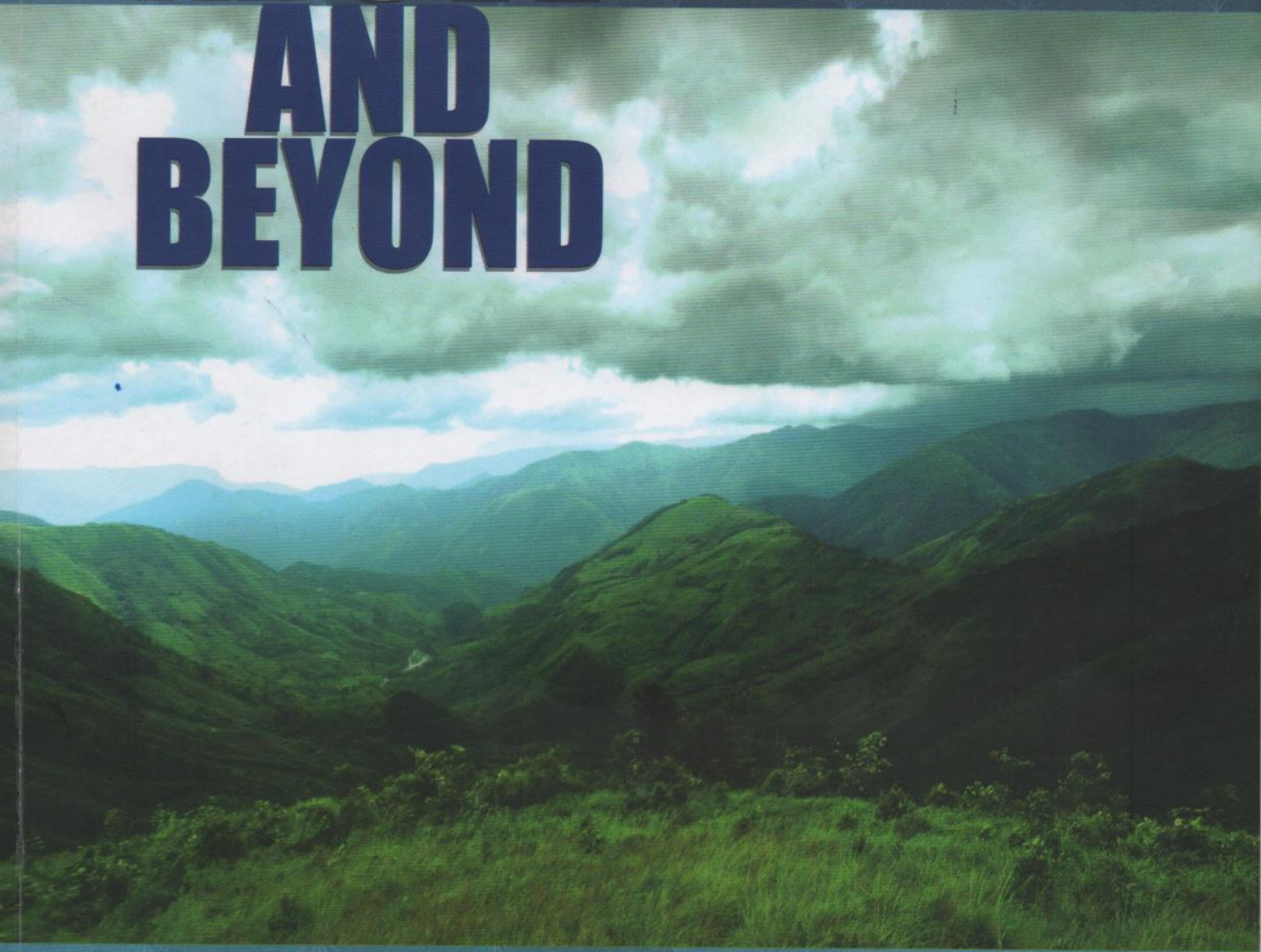
Theme

ABOVE AND BEYOND



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