

# Impact of Ergonomics in Laparoscopic Surgery on Surgeon Health: An Analytical Study

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**Abstract:** *Laparoscopic surgeries, while minimally invasive and beneficial for patients, can present significant ergonomic challenges for surgeons. Poorly designed equipment and challenging operating environments lead to musculoskeletal strain, including carpal tunnel syndrome, cervical spondylosis, and eye strain. This study investigates the prevalence of physical discomfort among laparoscopic surgeons in Bangalore and evaluates their awareness of ergonomic principles. Through a questionnaire distributed to 100 surgeons, results indicate that most surgeons experience significant physical strain during surgeries, with varying levels of ergonomic awareness and adaptation in their practices.*

**Keywords:** Ergonomics, Laparoscopic Surgery, Surgeon Health, Musculoskeletal Pain, Operating Room Design

## 1. Introduction

Minimally invasive procedures, especially laparoscopic surgery, have become increasingly popular in the last two decades. This method uses smaller incisions, resulting in less postoperative pain, shorter hospital stays, quicker recoveries, and better access to certain areas. Since its introduction in the late 1980s, laparoscopic surgery has evolved, allowing for more complex operations with less discomfort for patients<sup>1</sup>.

However, there are drawbacks. Surgeons often face fatigue and discomfort due to complex technology and poorly designed equipment<sup>2</sup>. Reports have indicated that surgeons experience issues like carpal tunnel syndrome, eyestrain, and cervical spondylosis, particularly in high - volume settings<sup>3</sup>. Additionally, awkward grips on instruments can lead to thenar neuropathy<sup>4</sup>.

To improve efficiency, safety, and comfort, it is crucial to apply ergonomic principles in the operating room. Understanding ergonomics can enhance surgeon comfort and reduce physical strain<sup>5</sup>. In the early years of laparoscopic procedures, many patients experienced significant discomfort and complications, often due to avoidable errors that could have been mitigated with a better grasp of the procedure's mechanics. The operating room environment, complicated by complex machines, has made interactions between surgeons and patients more challenging<sup>6</sup>.

### Ergonomics:

Ergonomics, derived from the Greek words “ergon” (work) and “nomos” (natural laws), is the scientific study of how to optimize people’s work environments. It focuses on equipment design, workplace layout, safety, productivity, and training, integrating principles from anatomy, physiology, psychology, and engineering. In essence, ergonomics seeks to fit the worker to their job, enhancing comfort and efficiency. Since its formal definition in 1949, it

has significantly improved safety and effectiveness in various fields, including laparoscopic surgery<sup>7</sup>.

### Importance of Ergonomics:

The significance of ergonomics in laparoscopic procedures is critical. Research indicates that proper ergonomic practices can reduce suturing time and alleviate pressure - related chronic pain among surgeons. The use of ergonomically designed tools has been shown to enhance comfort and efficiency in the operating room, highlighting the need for ergonomic considerations in surgical settings<sup>8</sup>.

## 2. Aim of the Study

- 1) Investigate the prevalence of symptoms among the laparoscopic Surgeons and correlation between Surgery and operating room ergonomics.
- 2) To assess the relation between physical discomfort of surgeon and equipment used.
- 3) To assess the awareness about ergonomics guidelines and it's application.

## 3. Methods

A questionnaire was created and distributed to approximately 100 laparoscopic surgeons in Bangalore, India, to assess the frequency and intensity of physical discomfort they experienced, along with their awareness of contributing factors. The survey was shared through email, Whatsapp, and in hard copy format.

The response sheets were analyzed.

Design of the study is Prospective study.

- General Surgeons performing laparoscopic Surgeries.
- The survey was conducted by means of a questionnaire.

### Questionnaire

- 1) 34 Questions
- 2) Arranged in 4 chapters
  - Demographics (1 - 10)
  - Physical Symptoms (11 - 18)

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- Environment and equipment (19 - 30)
- Ergonomics (31 - 34)

### Instructions

- 1) Please answer each question as honestly as possible. This is not a test and there is no right or wrong answer.
- 2) Your answers are completely confidential and shall be used for study or research purpose only.

## 4. Results

The study was conducted among general surgeons practicing laparoscopic procedures in Bangalore, India 138 questionnaires was sent to the laparoscopic surgeons.

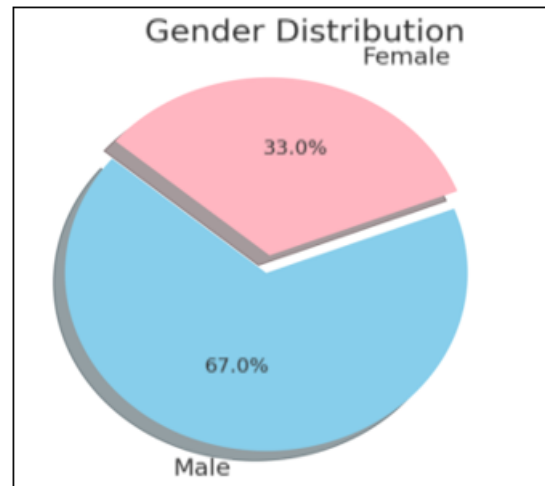
Among these 100 responded.

The duration of practice as a laparoscopic surgeon was taken into account. Operating room factors considered included the height of the operating table, the height of the monitor, the size of the monitor often used, and the size of the monitor most comfortable to use.

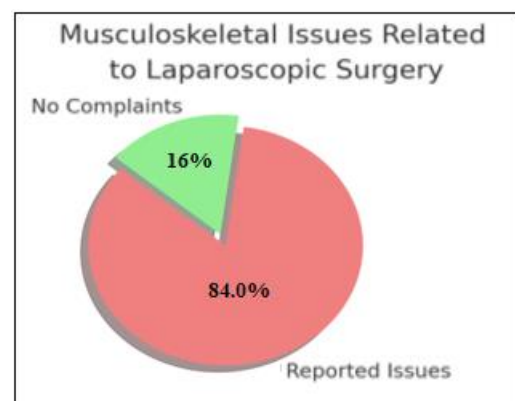
Physical discomfort factors considered were neck pain, shoulder pain and finger pain, numbness, eye strain and arm pain, ankle pain.

Age in years	Mean - 39 years
Height in cms	171cm
Gender	Male - 67, Female - 33
Dominant Hand	Right - 98 Left - 2
Years of experience	<5 years - 64.2% 5 - 10 years - 18.1% >10 years - 17.2%
No. of cases performed per week	<5 cases - 80.7% 5 - 10 cases - 18.8%
Types of Laparoscopic Surgeries	Basic - 90.1% Advanced - 8.7%
Completed a laparoscopic training/fellowship	Yes - 72.2% No - 25.8% In Training - 2%

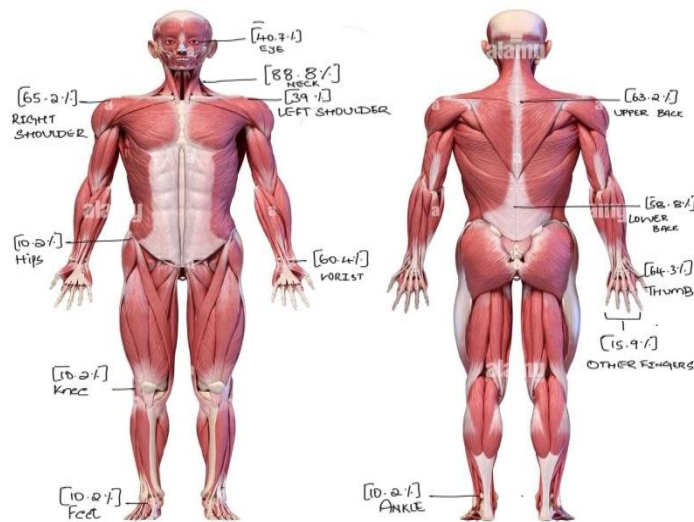
In our study average age of surgeons was 39years, (male - 67; Female - 33). Mean height of surgeons was 171cms, with most of them were right handed.



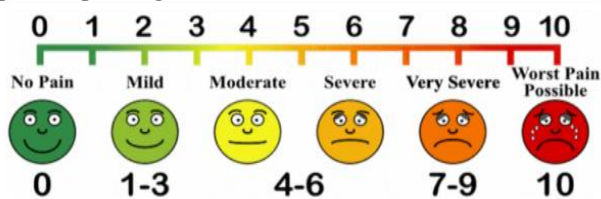
In our study, 64.2% of participants (65 surgeons) had less than 5 years of experience, 18.1% (18 surgeons) had 5 - 10 years, and 17.2% (17 surgeons) had over 10 years. Most respondents practiced basic laparoscopic procedures (90.1%, or 102 surgeons), while 8.7% (10 surgeons) focused on advanced laparoscopy. Among the participants, 72.2% (71 surgeons) completed a laparoscopic training or fellowship program, 25.8% (25 surgeons) had no training, and 2% (4 surgeons) were currently in fellowship training. When asked about symptoms in their hands, wrists, shoulders, neck, legs, or back, 84 surgeons reported musculoskeletal issues related to laparoscopic procedures, while 15.9% (16 surgeons) did not report any complaints.



Most surgeons reported experiencing pain or discomfort in various areas, with the following frequencies: neck (88.8%), right shoulder (65.2%), thumb (64.3%), upper back (63.2%), wrist (60.4%), lower back (58.8%), and eye pain (40.7%), along with discomfort in other joints.

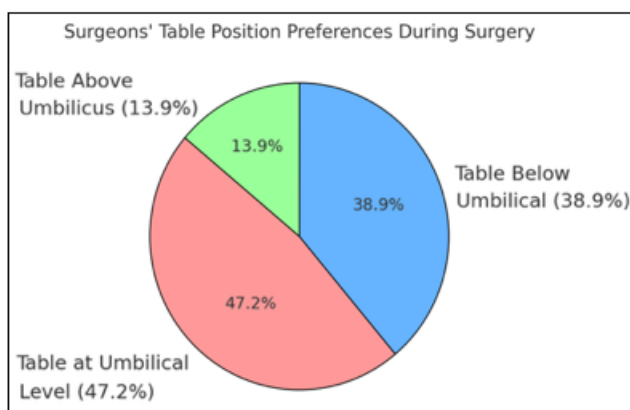


Depicting various sites or musculoskeletal pain in laparoscopic surgeon

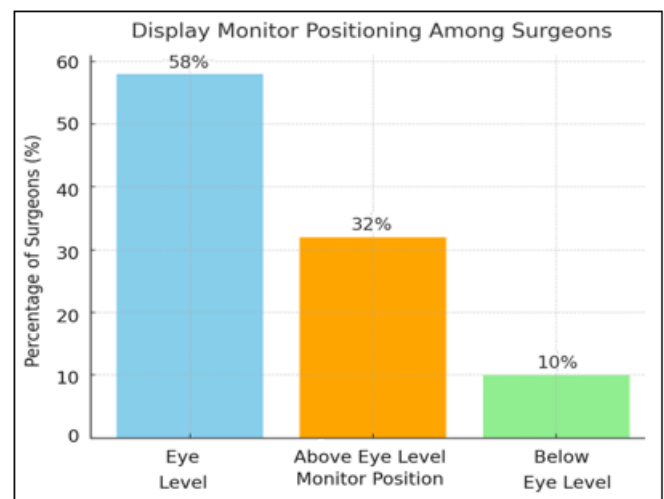


Grading of physical discomfort using Visual analog score in laparoscopic surgeon

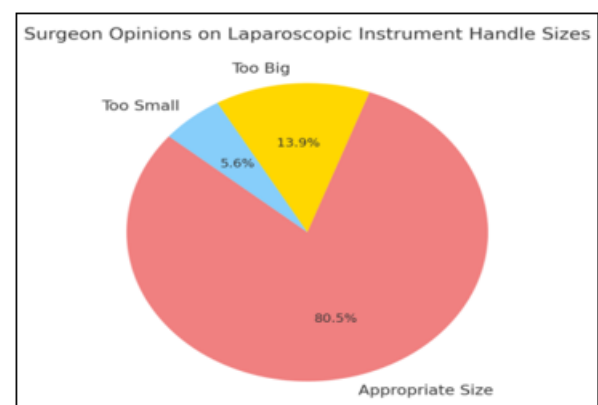
In our study, 85 surgeons reported experiencing physical discomfort both during and immediately after surgery, while 65 felt discomfort only after the procedure. Additionally, 10 surgeons experienced intermittent pain throughout the surgery, and 6 reported persistent pain during the operation. To manage their discomfort, 15.8% of surgeons sought treatments like massage, physiotherapy, ultrasonic stimulation, and oral analgesics. In terms of strategies to reduce discomfort during laparoscopic surgery, 64.6% (64 surgeons) adjusted their posture, 25.1% (25 surgeons) took breaks, 4.8% (4 surgeons) changed instruments, and 8% (8 surgeons) chose to ignore the discomfort.



The operating table height was positioned at the umbilical level for 47.2% of surgeons, above the umbilical level for 13.9%, and below the umbilical level for 38.9%. The display monitor was at eye level for 58.6% of surgeons, above eye level for 32.2%, and below eye level for 9.2%.

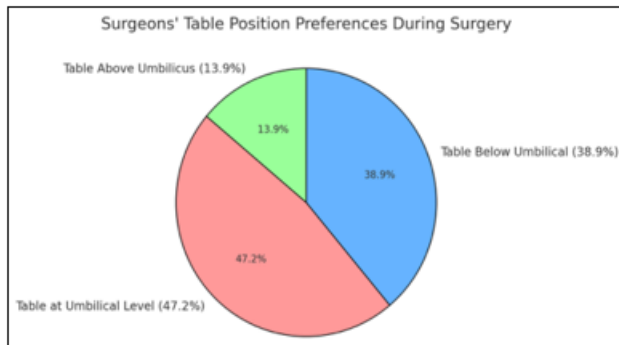


Regarding laparoscopic instrument handles, 80.6% (81 surgeons) found the handle size appropriate, 13.9% (14 surgeons) felt the handles were too big, and 5.6% (5 surgeons) thought the handles were too small.



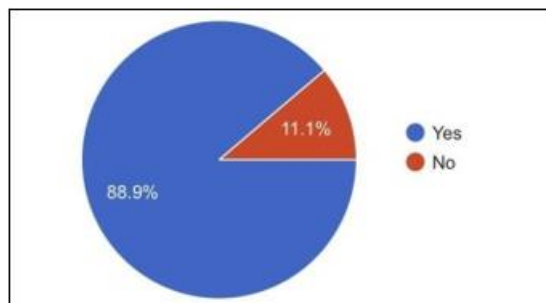
About 72.2% (73 surgeons) reported using laparoscopic instruments of optimal length when available, while 38.9% experienced discomfort with commonly used foot pedals. A majority, 74.2% (75 surgeons), preferred the open method for port insertion, and 69.8% (70 surgeons) customized port insertion based on the patient's abdominal wall anatomy. Most surgeons favored using Hook and Bipolar instruments for electrocautery. All surgeons acknowledged the

importance of having trained laparoscopic assistants during procedures. In our survey, 41.7% of surgeons were aware of ergonomic principles, 30.6% were somewhat aware, 8.3% were not aware, and 11.1% were very much aware of ergonomics.

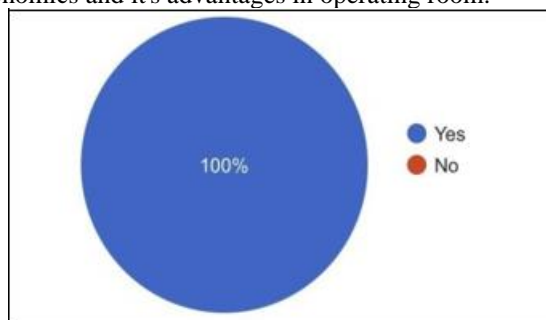


Awareness of ergonomics principles was found to be through surgical training, online, regional or national meetings and laparoscopic products and representatives.

About 88.9% of surgeons were implementing ergonomic principles in laparoscopic surgery were in 11.1% were not.



All surgeons (100%) stressed about the importance of ergonomics and its advantages in operating room.



## 5. Discussion

Laparoscopic procedures offer benefits like shorter recovery times for patients but can lead to mental fatigue and musculoskeletal issues for surgeons. While some ergonomic strategies and tools have been implemented, there is still limited understanding of how surgeons assess their operating room environments and how this affects the adoption of ergonomics practices. Studies show that complaints from surgeons decrease with more than five years of experience, as experienced surgeons are better at tool manipulation and aware of risk factors, reducing their discomfort<sup>(14, 15)</sup>.

Monitor placement is a key ergonomics factor; guidelines suggest positioning monitors directly in front of surgeons and slightly below eye level to avoid neck strain. However, many surgeons do not follow these guidelines, leading to neck discomfort<sup>(17)</sup>. Additionally, most respondents positioned the operating table at levels not aligned with ergonomic recommendations, which could lead to strain during procedures<sup>(18)</sup>.

While advancements in instrument design have improved ergonomics, issues with hand-held instruments and foot pedals persist. Many surgeons remain unaware of ergonomics guidelines and have not received specific training, with only 9% being well-versed in ergonomics practices. Despite this, nearly all agree on the importance of ergonomics in the operating room<sup>(20)</sup>.

Studies have shown that simulated skills labs can help raise awareness of ergonomics factors<sup>(21)</sup>. Overall, there is a pressing need for increased awareness and training on ergonomics practices among laparoscopic surgeons, along with the development of more ergonomics instruments to enhance working conditions.

## 6. Conclusion

Ergonomic challenges in laparoscopic surgery pose a significant risk to surgeons, leading to musculoskeletal strain and impacting their overall efficiency. This study emphasizes the importance of adopting ergonomic guidelines and improving surgical equipment to reduce physical discomfort and enhance the wellbeing of surgeons. Training and awareness of ergonomics are critical to improving surgical outcomes and ensuring the health of surgeons.

## References

- [1] Berguer R. Surgical technology and the ergonomics of laparoscopic instruments. *Surg Endosc* 1998; 12: 458 - 62.
- [2] Berguer R. Surgical technology and the ergonomics of laparoscopic instruments. *Surg Endosc* 1998; 12: 458 - 62.
- [3] Uchal M, Brogger J, Rukas R, Karlsen B, Bergamaschi R. In-line versus pistol-grip handles in a laparoscopic simulators. A randomized 27. controlled crossover trial. *Surg Endosc* 2002; 16: 1771 - 3.
- [4] Hemal AK, Srinivas M, Charles AR. Ergonomic Problems Associated with laparoscopy. *J Endourol* 2001; 15: 499 - 503.
- [5] Berguer R, Forkey DL, Smith WD. Ergonomic problems associated with laparoscopic surgery. *Surg Endosc* 1999; 13: 466 - 8.
- [6] Curtis P, Bournas N, Magos A. Simple equipment to facilitate operative laparoscopic surgery (or how to avoid a spaghetti junction). *Br J Obstet Gynaecol* 1995; 102: 495 - 7.
- [7] Kilbom A. Measurement and assessment of dynamic work. In: Wilson EC Jr, editor. *Evaluation of human work: a practical ergonomics methodology*. London: Taylor and Francis; 1990. p.6 41 - 661.



- [8] Van Veelen MA, Meier DW. Ergonomics and design of laparoscopic instruments: results of a survey among laparoscopic surgeons. *J Laparoendosc Adv Surg Tech A* 1999 Dec; 9 (6): 481 - 489.
- [9] Hanson DL. Evaluation of the Hawthorne effect on physical education research. *Res Q* 1967; 38: 723 - 4.
- [10] Veelen V, Kazemier J. Improved physical ergonomics of laparoscopic surgery. *MinimInvasive Ther Allied Technol*.2004; 13: 161 - 6.
- [11] van Veelen MA, Meijer DW, Uijtewaal I, Goossens RH, Snijders CJ, et al. Improvement of the laparoscopic needle holder based on new ergonomic guidelines. *Surg Endosc*.2003; 17: 699 - 703.
- [12] Manasnayakorn S, Cuschieri A, Hanna GB. Ergonomic assessment of optimum operating table height for hand - assisted laparoscopic surgery. *Surg Endosc*.2009; 23: 783 - 9.
- [13] van Veelen, Meijer DW, Goossens RH, Snijders CJ. New ergonomic design criteria for handles of laparoscopic dissection forceps. *J Laparoendosc Adv Surg Tech*.2001; 11: 17 - 26.
- [14] Sari V, Nieboer TE, Vierhout ME, Stegeman DF, Kluivers KB. The operation room as a hostile environment for surgeons: physical complaints during and after laparoscopy. *Minim Invasive Ther Allied Technol*.2010; 19: 105 - 9.
- [15] Hemal AK, Srinivas M, Charles AR. Ergonomic problems associated with laparoscopy. *J Endourol*.2001; 15: 499 - 503.
- [16] Uhrich ML, Underwood RA, Standeven JW, Soper NJ, Engsberg JR. Assessment of fatigue, monitor placement, and surgical experience during simulated laparoscopic surgery. *Surg Endosc*.2002; 16: 635 - 9.
- [17] Berguer R, Forkey DL, Smith WD. Ergonomic problems associated with laparoscopic surgery. *Surg Endosc*.1999; 13: 466 - 8.
- [18] van Veelen MA, Kazemier G, Koopman J, Goossens RH, Meijer DW. Assessment of the ergonomically optimal operating surface height for laparoscopic surgery. *J Laparoendosc Adv Surg Tech*.2002; 12: 47 - 52.
- [19] van Veelen MA, Snijders CJ, van Leeuwen E, Goossens RH, Kazemier G. Improvement of foot pedals used during surgery based on new ergonomic guidelines. *Surg Endosc*.2003; 17: 1086 - 91.
- [20] Bagrodia A, Raman JD. Ergonomics considerations of radical prostatectomy: physician perspective of open, laparoscopic, and robot - assisted techniques. *J Endourol*.2009; 23: 627 - 3