



Unresolved Issues in Surgeon Ergonomics

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Robotics Has Not Yet Solved Surgeon Ergonomics

The advent of robotics in surgery has undoubtedly addressed various intraoperative challenges, notably improving surgeon ergonomics by enabling them to operate in a seated position.¹ However, the question lingers: is the ergonomic problem for surgeons genuinely solved?

Recent survey responses from conventional robotic-assisted surgery system users add an intriguing layer to this narrative. When posed with the question, “If there was an alternative method to prevent pain or soreness during operations, would you alter your current practice?” The results suggest room for improvement. A noteworthy 43.9% of respondents answered affirmatively, expressing a willingness to explore alternative solutions, while 34.5% remained uncertain, hinting at a lingering need for advancements in addressing ergonomic concerns in robotic surgery.² This narrative underscores the dynamic nature of the field, urging further exploration and innovation to enhance the ergonomic experience for surgeons.



Surgeon ergonomic risks associated with open and lap surgery



Risks are partially mitigated with robotics, giving surgeons the ability to operate in a seated position



Further ergonomic risks are reduced with Senhance Surgical System by supporting more comfortable head and neck positioning



Ergonomics closer to be fully addressed with LUNA Surgical System



Prevalence & Impact

The prevalence and impact of ergonomics on laparoscopic surgeons is staggering. A significant 93% of surgeons report suffering from musculoskeletal pain, 77% experiencing multisite pain.⁴ The alarming finding that 77% of surgeons reported pain in two or more body sites underscores the severity of the issue. Multisite musculoskeletal pain has been linked to diminished work ability, potential career shortening, and increased risks of long-term sickness absence.³ A concerning 40% of surgeons resort to using painkillers several times a month, with 22% relying on them weekly or daily.³ Furthermore, 21%-40% of surgeons experiencing multisite pain report negative impacts on work, leisure time, and sleep.³

While the introduction of robotic-assisted surgery, as indicated by the lower REBA scores for operating in a seated position (6.65 vs. 3.35, $p < 0.0001$)⁴, seems promising for addressing ergonomic issues, the data reveals persistent challenges. A significant 54.1% attribute physical pain during robotic surgery to the ergonomics of the da Vinci system, and 46.2% believe discomfort is mainly from performing robotic surgery compared to other procedures.² The majority (60.8%) report tilting their head downward during operation, and specific musculoskeletal symptoms after surgery include 30.3% for cervical muscles, 28.4% for shoulder muscles, and 23.3% for lumbar spine muscles.² In robotic-assisted laparoscopic surgery, the neck emerges as the most prevalent painful body site (23%).³ Addressing these challenges is crucial for ensuring the well-being and longevity of surgeons' careers.



Asensus Focus on Surgeons

Asensus is focused on addressing surgeon ergonomics as we believe it has a direct impact on patient outcomes. Surgeon ergonomics is optimized within the Senhance Surgical System primarily with design details on the surgical cockpit, ensuring the comfort and consequent precision necessary for delicate procedures. Seated at the ergonomic cockpit, surgeons teleoperate using surgical instruments attached to manipulator arms while viewing the operative site on a monitor. Key to this optimization is the provision of an ergonomic chair designed to support the surgeon throughout the procedure. These chairs feature adjustable height, armrest position, backrest tilt, and monitor height settings, facilitating personalized comfort and optimal positioning for enhanced performance. Furthermore, a built-in chair ensures proper position with the cockpit, maintaining consistent ergonomic alignment. While the cockpit chair is set at a fixed distance from the monitor to aid in locating the correct eye sensor positioning, surgeons are encouraged to make further adjustments as needed to tailor the setup to their individual comfort and ergonomic requirements. This comprehensive approach to ergonomic optimization could not only prioritize surgeon well-being but also contribute to optimized surgeon performance.

With the next generation robotic and instrument system, LUNA Surgical System, currently in development, ergonomics is a key input to be fully addressed for both the surgeon and OR staff. Early evaluations from key opinion leaders and subject matter experts are gleaning insights into how impactful the ergonomic benefits are with the new console design, particularly as they pertain to patient outcomes.⁶



REBA Study Results

REBA Overview

REBA (Rapid Entire Body Assessment) methodology is used to quantify ergonomic risk based on user body positions during standard tasks. Specifically designed to assess the postures and movements adopted during work activities, REBA considers factors such as body posture, force exertion, and repetition. In the realm of surgery, this assessment method serves as a valuable tool to comprehensively evaluate the ergonomic aspects of a surgeon's interactions with the equipment and workspace. By utilizing observational techniques and capturing relevant data during surgical procedures, REBA allows for a detailed examination of body positioning, identifying potential stress points and ergonomic challenges. The resulting scores generated through the REBA analysis provide a quantitative measure of ergonomic risk, facilitating a targeted understanding of areas that may require intervention or improvement to enhance the overall ergonomic experience for surgeons in the operating room.

In a recent review of literature, the REBA methodology has been used to score laparoscopy and da Vinci robotic approaches. Although scores are generally lower with robotics than laparoscopy, robotic scores are still in the medium/moderate risk category, drawing the conclusion that the ergonomics problem is not yet fully solved and has room for improvement to have an impact on long-term surgeon risk.^{7,8}

Methodology

In December 2023, an animal lab evaluation was held focusing on the design of the surgeon console and robotic arms for Asensus' new platform, LUNA Surgical System. Part of this evaluation was a blinded study based on REBA methodology involving taking images of surgeons and Subject Matter Experts (SMEs) during their evaluation during various procedures during an animal lab. Images were taken at random points during each surgeon's evaluation in typical and worst-case body positions during an average surgery. Angles were then measured per the REBA guidelines, specifically focusing on upper arm, lower arm, and wrist angles as these were most heavily impacted by the LUNA console. Based on these measurements, the REBA Assessment Worksheet was completed for each participant in which each measurement was assigned a point value in order to calculate a final overall score to quantify the ergonomic risk. This systematic approach provided an objective way to assess ergonomic risk of the LUNA console design as well as valuable insights into the ergonomic challenges faced by surgeons in the operating room, laying the foundation for a comprehensive understanding of the factors contributing to unresolved ergonomic issues in surgical practices.

Results

The average score of the 9 surgeons/SMEs that were evaluated was 2.22 (range 2-3), concluding that the LUNA console design demonstrates a low risk for long-term musculoskeletal disorders. This assessment takes into account full body positions but, as expected, the variation in scores came only from upper and lower arm positions. Negligible risk scores came from positions of the wrist, neck, trunk, and leg.⁹

Final REBA Scores

MIN	2
MAX	3
AVG	2.22

Score	Level of MSD Risk
1	negligible risk, no action required
2-3	low risk, change may be needed
4-7	medium risk, further investigation, change soon
8-10	high risk, investigate and implement change
11+	very high risk, implement change

Conclusion

In conclusion, despite significant advancements in robotic surgery aimed at enhancing surgeon ergonomics, this paper underscores the persistent challenges that remain unresolved. While the introduction of robotic-assisted surgery has undoubtedly improved certain aspects of ergonomic comfort, the data reveals ongoing concerns, with a considerable proportion of surgeons still experiencing musculoskeletal pain and discomfort. The insights collected from recent survey responses and REBA methodology highlight the continued need for innovation and refinement in ergonomic design to optimize surgeon well-being and performance in the operating room. Asensus Surgical's commitment to addressing surgeon ergonomics through meticulous cockpit design and ergonomic chair provision exemplifies a proactive approach to this issue. Moreover, the promising findings from the REBA study conducted on the LUNA Surgical System underscore the importance of ongoing research and development in this critical area. Moving forward, a concerted effort to prioritize surgeon ergonomics in surgical innovation will not only enhance surgeon comfort but also contribute to improved patient outcomes and the overall advancement of surgical practice.



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