Ergonomic Mobility Vest: A Solution to Alleviate Upper Body Musculoskeletal Disorders in Surgeons

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Background

The strenuous task of surgery puts the human body under severe stress throughout long operations. Surgeons must remain still for hours to execute lifesaving surgical operations, which can have a seriously negative impact on their musculoskeletal health. The occurrence of musculoskeletal disorders among surgeons is a common theme in occupational health studies. Standing in static postures can cause discomfort, increase stress, and hinder performance in the operating room (Alleblas et al., 2017). According to a research study conducted by Alleblas et al. (2017), only 17% of surgeons reported having no musculoskeletal discomfort during the span of a one-month study (Alleblas et al., 2017). Since surgery is a physically demanding job, surgeons are at a high risk of acquiring work-related musculoskeletal disorders (WMSDs). According to research conducted by Gorce & Jacquier-Bret (2024), WMSDs occur in more than 80% of surgeons at some point during their employment (Gorce & Jacquier-Bret, 2024). The most frequently affected body parts are the neck, shoulders and hands (Gorce & Jacquier-Bret, 2024). Neck pain affects 82% of surgeons who conduct invasive surgical procedures (Gorce & Jacquier-Bret, 2024). Shoulder pain is also common, affecting 51%-77% of surgeons (Gorce & Jacquier-Bret, 2024). The overall wrist pain impacts 31.3% to 38.3% of surgeons (Gorce & Jacquier-Bret, 2024). The study reported that incidence rates range from 39.0% to 71.7% for the lower back as well (Gorce & Jacquier-Bret, 2024). The frequency is even higher during long surgeries where stillness and precise movements are vital (Gorce & Jacquier-Bret, 2024). Wong et al. (2024) conducted an extensive review that focused on reducing upper limb musculoskeletal pain in robotic surgeons. This study aimed to decrease shoulder pain by keeping elbows on strategically placed armrests. The study found that ergonomic changes, such as maintaining a neutral posture and properly using armrests, could considerably minimize fatigue of muscles and upper limb pain during operations (Wong et al., 2024). Although distinct from robotic surgery, this is relevant to common surgical practices such as open-heart surgery and orthopedic procedures, which also require static postures and repetitive movements.

Significance

Surgery is an essential medical procedure that can both save lives and greatly enhance a patient's quality of life (*Why safe surgery*, 2023). However, the demanding nature of surgical procedures, especially the prolonged static postures and precise movements required, places immense strain on surgeons' upper bodies (Alleblas et al., 2017). This emphasizes the need to put solutions like an ergonomic mobility vest (EMV) into practice. This can assist in relieving musculoskeletal disorders (MSD's) of the upper body. This not only improves the physical health of surgeons but also increases their productivity and concentration during life-saving procedures by providing relief. The lack of ergonomic solutions specifically intended to meet the needs of surgeons throughout long procedures and precise motions reveals a huge research gap in the treatment of upper body musculoskeletal disorders (MSDs). While ergonomic tools like anti-fatigue mats and pressure-absorbing footwear have been studied, physical therapies for the upper body are still limited. This gap creates opportunities for innovation in ergonomically designed compression gear that can give targeted support, enhance posture, and reduce stress in the upper body. This work seeks to close this gap by offering a unique technique for improving surgical operations and lowering MSD's.

Objectives & Hypotheses

The objective of the study is to create and assess ergonomic compression equipment specifically designed to lessen upper-body musculoskeletal disorders (MSDs) in surgeons. By improving posture, reducing muscular tension, and improving surgical procedures, this equipment aims to improve surgical efficiency. The research question for this study is: How can ergonomically designed compression gear in the form of an ergonomic mobility vest (EMV) help reduce upper body musculoskeletal disorders (MSDs) and improve health among surgeons during surgical procedures? The research hypothesis of this study is: The Ergonomic Mobility Vest (EMV) will significantly reduce the prevalence of upper body musculoskeletal disorders and improve posture in surgeons during various surgical procedures compared to traditional surgical wear. Short-term goals include assessing the EMV's effectiveness in lowering pain and tiredness during experimental procedures. The study aims to collect data, improve breathability, improve performance, and raise awareness of ergonomic issues in surgery. These goals benefit surgeons instantly. The main long-term goal is to make the Ergonomic Mobility Vest (EMV) a commonplace instrument in operating rooms, lowering the incidence of musculoskeletal disorders (MSDs) and enhancing the upper body health of surgeons. Through better ergonomic behaviors and applying these advancements to other high-stress occupations, this research seeks to improve patient care, enhance surgical success, and improve the lives of hardworking surgeons.

Methods / Tools

Ergonomic Mobility Vest (EMV) as the Primary Tool

The Ergonomic Mobility Vest (EMV) is the study's centrepiece, aimed to reduce musculoskeletal diseases (MSDs) in surgeons by focusing on critical regions of stress. Compression zones support the neck, minimizing stress from static postures, while adjustable cushioning alleviates shoulder discomfort and fatigue. The upper back benefits from posture-enhancing elements that promote alignment and reduce strain during prolonged procedures. The EMV improves posture and decreases compensatory stress on the lower back. Its customizable size offers comfort across a wide range of body shapes, and the breathable, lightweight materials minimize overheating, making it ideal for long procedures.

Quantitative Data

Validated tools will measure the physical and subjective impacts of the EMV. The Visual Analog Scale (VAS) for Pain will track self-reported pain levels before and after surgeries, providing reliable numerical data. The Fatigue Severity Scale (FSS) will evaluate post-surgery fatigue. Weekly assessments, alongside baseline and follow-up surveys, will capture changes in musculoskeletal health and document pre-existing conditions. Additional demographic and workload data, such as age, sex, race, surgical experience, and surgery duration, will add context to the findings.

Qualitative Data

Participant feedback is crucial for refining the EMV. Weekly semi-structured interviews will collect insights on comfort and usability. Observations will be recorded based on posture, movement and ergonomic challenges.

Objective Ergonomic Evaluations

Objective tools will validate the EMV's effectiveness in reducing strain. Rapid Upper Limb Assessment (RULA) will assess ergonomic risks before and after the intervention.

Implementation and Data Management

A digital data collection platform will centralize all findings, ensuring accurate comparisons. Participants will maintain weekly logs to document their experiences with the EMV, including pain, fatigue, and usability feedback.

Methodology

This study will utilize a mixed-methods approach, integrating both quantitative and qualitative analyses to thoroughly evaluate the effectiveness of the Ergonomic Mobility Vest (EMV) in reducing upper body musculoskeletal disorders (MSDs) among surgeons. By combining experimental and longitudinal methodologies, the study aims to capture short- and medium-term impacts of this intervention on surgeons' health and performance. The research design will include a control and experimental group, with data collected at baseline and after a fixed number of surgeries to ensure standardization.

Study Design

The research will adopt an experimental trial design with a longitudinal approach. Participants will be randomly assigned to either the control or experimental group. The study will measure outcomes after participants complete 20 surgical procedures, ensuring that the evaluation is based on workload rather than a fixed time period. This design allows for a detailed comparison of the intervention's effects on MSD symptoms.

Participant Recruitment

Participants will be recruited through professional networks, hospitals, and surgical centers, with outreach efforts including advertisements in social media platforms such as LinkedIn and newsletters and at professional conferences. Representation of diverse ethnicities, genders, and age groups will be prioritized to enhance the study's generalizability. The age range will be from 30 to 65 years.

Group Considerations

Sex, race and gender considerations will ensure that both male and female surgeons are equally represented, allowing the study to explore potential anatomical differences in the vest's effectiveness. Surgeons will be selected from hospitals with diverse ethnic demographics. The vest will have adjustability features to ensure comfortability for both genders. Age will also be factored into the analysis, with participants categorized into two subgroups: 30–45 years and 46–65 years, to assess whether the intervention's effectiveness varies with age.

Ethical Considerations

Participation will be entirely voluntary, and all participants will provide written informed consent prior to the study. Personal data will be anonymized.

Procedure

At the beginning of the study, all participants will undergo a baseline assessment to collect initial data. This will include self-reported pain and fatigue levels measured using the

Visual Analog Scale (VAS) for pain and the Fatigue Severity Scale (FSS). Objective ergonomic evaluations will also be conducted using tools such as the Rapid Upper Limb Assessment (RULA) to measure muscle strain and posture during surgeries. Participants will then be randomly assigned to one of two groups. The control group will perform surgeries wearing standard surgical gear without any additional interventions. The experimental group will wear the Ergonomic Mobility Vest (EMV), specifically designed to reduce upper body strain by providing compression and postural support during surgeries. Both groups will perform surgeries as usual over the course of 20 surgical procedures, after which data will be collected and analyzed. Throughout the intervention period, data will be collected weekly. This will include quantitative measures such as pre- and post-surgery pain. Additionally, qualitative feedback will be gathered through surveys or interviews, providing insights into the comfort, usability, and perceived benefits of the EMV.

Expected/Anticipated Outcomes

It is anticipated that the study will show that surgeons who use the Ergonomic Mobility Vest (EMV) during procedures will have significantly improved musculoskeletal health. In particular, it is expected that the experimental group wearing the EMV will experience less upper back, shoulder, and neck pain than the control group. It is anticipated that over the experimental period, quantitative data from the Visual Analogue Scale for Pain (VAS) and Fatigue Severity Scale (FSS) will demonstrate quantifiable decreases in physical stress. The Rapid Upper Limb Assessment (RULA) used to assess the differences between groups is expected to show decreased muscular stress in the lower and upper back, neck and shoulder. It is also expected to improve surgical efficiency as a result of the EMV. This study intends to show both the physiological and mental advantages of the EMV. The EMV is predicted to alleviate upper-body pain and fatigue, improving surgeons' physical well-being, especially during long-term treatments. The EMV is also predicted to improve concentration and precision by supporting good posture and reducing strain in the upper body.

Research Impact

With the development of the Ergonomic Mobility Vest (EMV), this research can have a major impact on the efficiency and overall health of surgeons. This research attempts to improve the physical health of surgeons and make their work more sustainable by treating musculoskeletal disorders, which are prevalent in surgery because of prolonged work hours, static positioning and repetitive movements. This can lead to better surgical precision, fewer disruptions, and potentially improved patient outcomes. Furthermore, this study has greater implications for occupations like nursing and lab technicians that need extended standing or repetitive motions. By demonstrating the possibilities of wearable ergonomic technology, this study promotes creativity in ergonomic workplace equipment beyond the field of surgery. This study closes a significant knowledge gap about the potential efficacy of upper-body ergonomic solutions and offers insightful information that may spur further developments. Lowering the amount of work-related injuries may eventually reduce healthcare expenditures while simultaneously improving quality of life for surgical workers.

Bibliography and Citations

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