

## VIEWPOINT

## A Primer on Optimizing Ergonomics in the Operating Room

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**Given what has been learned** about the importance of physician health for productivity, satisfaction, and career longevity, a review of correct body positioning and ergonomics is warranted in surgery. It is now abundantly clear and well documented in the literature that performing surgery takes a toll on one's body. A 2018 meta-analysis assessing the prevalence of work-related musculoskeletal disorders among surgeons<sup>1</sup> found that from 1997 to 2015, the prevalence of degenerative cervical spine disease and degenerative lumbar spine disease increased by 18.3% and 27%, respectively. Furthermore, of physicians with work-related disease, 12% required a leave of absence, practice restriction or modification, or early retirement. Another study found that 50% of surgeons cited posture alone as contributing to their symptoms.<sup>2</sup> Overall, 12 at-risk specialties described a gross lack of awareness and an unmet need for ergonomics education.<sup>1</sup> Indeed, the American College of Surgeons released a series of recommendations on surgical ergonomics in 2022.<sup>3</sup>

Just as we focus on training the correct position of surgical instruments, so too must we train the movement and position of surgeons' bodies. The US Occupational Safety and Health Administration (OSHA) recommendations for safe posture at the operating table are as follows:

- Head: Should be vertical and should not be tilted more than 15°.
- Back: Should be upright without bending joints into extreme positions.
- Torsion or flexion: Should not exceed 6° to 10°.
- Arms: Should hang normally at sides. Should not extend more than 16 to 18 inches from the body. Elbows should be bent at 90° to 120°. Height of hands should be between waist and middle chest.
- Lower body: Stand upright. Shift weight from one leg to another occasionally to avoid extensive eccentric contraction.<sup>4</sup>

Small deviations from the proper body position can have unexpectedly large consequences. For example, for every inch the head moves forward in space, the relative weight on the spine increases by 4.5 kg.<sup>2</sup> This effect is further exacerbated by the use of headlights and loupes. Key to maintaining appropriate posture in the operating room (OR) is knowledgeable use of often overlooked and underappreciated surgical instruments: the operating table, sitting stool, and standing stool. This is especially important not only when performing surgery with the aid of a microscope, which requires maintaining a rigid posture for a prolonged time, but also when performing laparoscopic surgery, which can routinely require arm positions out of the safe OSHA positioning, given the length and larger moment arm of laparoscopic instruments. The American College of Surgeons has detailed the ideal positioning of instruments to op-

imize positioning during laparoscopic surgery.<sup>3</sup> Furthermore, whenever possible, robotic surgery should be used, as this was developed to improve surgical ergonomics.

Extra time should be taken to ensure that operators have safe body position throughout the surgery. At the beginning, proper table position can be considered an additional step of the so-called surgical time-out. Table position can then be periodically checked as the surgery progresses and surgical positions change. First, the table should be adjusted so that the taller operator's body is in the safe position. The shorter operator can then use standing stools to match the taller operator's height. If needed, multiple stools can be stacked on each other. Ideally, these stools would have a tongue-in-groove mechanism to ensure stability when stacking, and more than 2 stools is inadvisable for safety concerns. Alternatively, the more optimal position might be the taller operator using a sitting stool, while the shorter stands normally. Choosing which of these configurations is ideal will depend on the preferences of the surgeons and the type of surgery being performed. There will likely be times where the ergonomics cannot be optimized perfectly for each surgeon at one time. Care must be taken to find a table height where the ergonomics are as close to ideal as possible for each surgeon. Using the airplane adjustment can offer subtle adjustments by increasing the height of 1 side of the table and lowering the other proportionally. Each surgeon should routinely check in with the other during the operation to see if table adjustments need to be made.

When opting for a sitting stool, the table height should allow for the neck, back, and arms to be in the ideal, safe position. The center of gravity on the stool should be through the ischial tuberosities, with the feet resting on the floor at a distance from the stool that places the knees at a 90° angle. Choice of a static or rolling stool is ultimately up to surgeon preference, but a rolling stool does offer the added benefit of easily moving in the xz plane to optimize upper-body positioning for different surgical moves as the surgery progresses. The stool must, however, have a working height (y plane) adjustment that can ideally be modified directly by the surgeon.

Ensuring safe positioning is especially important when using a microscope, as this tool requires remaining in a rigid position. Any minute change from ideal positioning can place great strain on the body. Even sustained force generated at 2% of a muscle's maximum voluntary contraction can result in decreased tissue oxygenation and risk subsequent injury.<sup>2</sup> A microscope offers the ability for both surgeons to look at the field with their necks and torsos in a completely neutral position, without any flexion or torsion. The same steps mentioned above should be applied to optimize ergonomics. This can sometimes be hard to achieve for both op-

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erators based on the location of the surgical field on the patient's body. Additional tips include ensuring arms are tucked when working on the head or torso. This will limit the need for rotation at the waist or neck of the surgeons. When working on the legs, use of a split-leg table can allow each operator to be on each side of the operative leg, which ultimately allows for more ergonomic posing than when operating on either side of both legs with a standard table.

Antifatigue mats and microbreaks are also important instruments. Antifatigue mats have been shown to decrease surgeon fatigue and pain and intraoperative errors.<sup>4</sup> Microbreaks are 10-minute breaks every 2 hours during a surgery. Not only have these tools been shown to improve surgeons' mental and physical focus, but they also do not lead to increased operative duration, disruptions in workflow, or increased distractions. Indeed, 90% of surgeons indicated a desire to implement microbreaks into their practice.<sup>4</sup> As part of these breaks, the Mayo Clinic has released a se-

ries of intraoperative OR stretches that have been shown to ameliorate pain and counteract the negative effects of operating positions on healthy posture.<sup>5</sup>

Preserving surgeons' body function can no longer be considered of secondary importance. Prioritizing optimal ergonomics in the OR is paramount not only to the success of an operation and the effective care of patients, but also to ensuring a long, healthy surgical career. Focus on proper ergonomics is a specialty-wide responsibility—individual surgeons should practice with proper positioning and care for their bodies, residency programs should educate their trainees on proper ergonomics, and professional societies should promote ergonomics awareness and guidelines. Maintaining the proper position of the surgeon's body is as important as maintaining the proper positioning of an instrument when dissecting. After all, there is arguably only 1 absolutely necessary surgical instrument for a successful operation—the surgeon's body.

#### ARTICLE INFORMATION

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