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Ergonomics in Endourology

Learning Objective: At the conclusion of this continuing medical education activity, the participant will be able to identify key risk factors that drive musculoskeletal pain and injury among endourologists; define the role of environmental factors, surgeon-specific factors (eg, posture and body mechanics), and device designs in maintaining optimal ergonomics during endourology procedures; and describe 4 preventive strategies that can be implemented to reduce musculoskeletal pain and injury during endourology procedures.

This AUA Update aligns with the American Board of Urology Module on Calculus, Laparoscopy-Robotics, and Upper Tract Obstruction. Additional information on this topic can be found in the AUA Core Curriculum sections on BPH and Urolithiasis.

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KEY WORDS: ergonomics, endoscopic surgery, musculoskeletal pain

OVERVIEW OF ERGONOMICS

Ergonomics is the field of study that investigates how workplace design can be leveraged to maximize efficiency and minimize injury of workers. Surgical ergonomics specifically focuses on the design and optimization of the operating room (OR) environment, surgical equipment, and team dynamics to reduce the risk of injury to surgeons and OR personnel. Surgeons have become increasingly cognizant of the detrimental effects that poor ergonomics can have on musculoskeletal (MSK) and mental well-being.[1,2] **Contemporary data suggest that 46% to 90% of urologists experience MSK pain attributed to performing surgery during their career.[3,4]** The location, severity, and type of MSK pain/injuries among urologists are linked to the procedures they perform (ie, neck, shoulder, low back for open surgery; eyestrain, neck pain, or hand/wrist strain during robotic/endoscopic procedures).[3,5-7] Endourology comprises the bulk of many urologists' surgical practice.[8] However, it remains understudied with respect to surgical ergonomics, and this may account for the high rate of MSK sequela among endourologists.[9] Of endourologists performing surgery for benign prostatic hyperplasia, over half have required ice, heat, or stretching; one-third required pharmacotherapy; and 4% reported discontinuing surgery for a period to allow recovery of symptoms.[10] **Additionally, 81% of endourologists performing flexible ureteroscopy (fURS) experienced MSK pain in at least 1 body region, 50% had pain that limited activities of daily living, and 29% sought medical evaluation for fURS-associated pain within the last year.[9] Chronic MSK pain and injury have been shown to increase rates of burnout and shorten surgical careers.[2]** Replacing urologists is expensive and reduces access to care when demand is high. Beyond the individual provider, lost productivity has significant economic ramifications for hospitals: a single urologist generates ~$2.2 million annually for a hospital; thus, 2 weeks of missed work could represent > $100,000 in lost hospital revenue.[11] **Urologists should be aware of key ergonomic principles and risk factors for injury while performing endoscopic surgery.**

General ergonomic principles in surgery. The main kinetic risk factors associated with work-related MSK pain/injury during surgery are repetitive movements, exertion of excessive force, and awkward and/or static postures.[6] **Awkward and static postures are the most relevant intraoperative ergonomic risks associated with endourology.** Subjective assessment of whether a posture is awkward is (anecdotally) surprisingly accurate, but objective tools are available. Rating systems like the rapid upper limb assessment measure ergonomic risk and direct targeted interventions.[12] Resources available through OSHA (the Occupational Safety and Health Administration) and the Department of Defense Environment Safety and Occupational Health Network suggest that companies prospectively consider ergonomics when designing work environments as well as monitoring injury reports (retrospectively) to guide workspace redesign.[13,14] The historically high percentage of self-employed surgeons, surgical culture (where pain is considered part of the job), and lack of knowledge of reporting processes have likely all contributed to significant underreporting of work-related injury. Poor reporting has likely contributed to the lack of substantial improvement in the ergonomics of the OR environment over time.

Risk factors for MSK pain/injury. Whether an individual surgeon experiences work-related MSK pain and injury appears to be a complex product of a variety of risk factors. Some factors are not modifiable, such as younger age, less experience, anthropometrics (shorter stature, smaller glove size, reduced grip strength), female gender, higher surgeon BMI, and medical comorbidities (eg, varicose veins, arthritis, neuropathy, circulatory disease).[5,6,15-17] Endourologists should focus improvement efforts on their modifiable risks (Table), with postures (intraoperative and at computer workstations) being of particular importance.[17]

The 2017 AUA Census found that among surgeons under 45 years of age, 65% of women urologists had work-related pain compared to 42% of men.[4] Anthropometric assessment of surgeons suggests that injury risk is related to hand size and grip strength, which varies by gender.[15,16] Many companies design devices and instruments using anthropometric measurement ranges that are outdated and assume the great majority of surgeons are males, despite changing demographics. Given these considerations, it is imperative that surgeons advocate that new instruments and equipment are designed to accommodate a wide variety of hand sizes and strengths, as well as support regulatory reform that would streamline adjustments to equipment and instruments that are already on the market.

Ergonomics education. Ergonomics education is lacking, and studies suggest that surgeon posture and OR setup can be optimized without compromising workflow.[18] Studies have found that 0% to 16% of urologists receive formal training in surgical ergonomics despite > 90% demonstrating interest in receiving such education.[9] A working knowledge of ergonomic best practices in OR layout may not naturally develop during residency or endourology fellowship training as these concepts are not routinely included in surgical education.[9] Unlike surgical technique, which typically improves over the course of one's career, it is unclear whether endourology experience and annual case volume are associated with higher risk (eg, cumulative stress load) or lower risk (eg, optimized posture, OR layout) of MSK pain/injury.[5,17] **Nonetheless, studies suggest that greater adherence to ergonomic best practices is independently associated with lower odds of MSK pain and injury during endourology procedures.[9]**

To date, there are no ergonomics guidelines specific to performing endoscopic surgery. However, many of the ergonomic considerations from other specialties and modalities can be applied. In this Update, we attempt to synthesize the limited available data on endourologic ergonomics, and where there are gaps, we provide practice recommendations based on expert opinion or data from other modalities or specialties. For the purposes of this Update, we are defining endourologic

ABBREVIATIONS: flexible ureteroscopy (fURS), musculoskeletal (MSK), operating room (OR), percutaneous nephrolithotomy (PCNL)

Table. Modifiable Ergonomic Risks for Surgeons

Risk: body mechanics	Recommendations
→ Repetitive movements → Prolonged periods in awkward postures → Prolonged static positions → Standing for long periods of time → Prolonged use of computer mouse/typing → Poor endurance, muscle fatigue → Insufficient recovery time 	✓ Maintain neutral working postures ✓ Adjust monitors (facilitate gaze-down position, avoid axial rotation) ✓ Postural resets ✓ Intraoperative and between-surgery stretches ✓ Position patient to minimize distance between surgeon and target anatomy ✓ Incorporate ergonomic considerations into the surgical time-out ✓ Alternate sitting and standing when possible ✓ Optimize corrective eyewear for workspace ✓ Use supportive hose ✓ Use antifatigue mats ✓ Dictate rather than type when possible ✓ Ergonomically optimize computer workstation, adjustable desk, ergonomic chair ✓ Regular exercise and strength training (12-15 min, 3-5 d/wk) ✓ Alternate surgical days with clinic and administrative time when feasible
Risk: equipment type, location	**Recommendations**
→ Heavy lead aprons → Video monitors on top of tower and lateral to OR bed 	✓ Wear lightest lead available, remove between cases ✓ Use 2-piece lead or 1-piece with snug belt to distribute weight ✓ Adjust monitors (facilitate gaze-down position, avoid axial rotation)
Risk: instruments/scopes	**Recommendations**
→ Heavy scopes → Instruments difficult to palm 	✓ Consider lighter scopes (such as disposables) ✓ Improve design of instruments, taking range of anthropometrics into account
Risk: lifting and moving patients	**Recommendations**
→ Lifting obese or uncooperative patients → Lateral transfer of the patient from bed to stretcher 	✓ Always lift with at least 2 people, coordinate the lift ✓ Use mechanical assistance devices for obese patients ✓ Do not twist while lifting
Risk: practice characteristics	**Recommendations**
→ High surgery volume → High patient acuity → Long, complex URS and PCNL cases → 12-h OR blocks, elective surgery >5 d/wk 	✓ Alternate complex with simple cases ✓ Mix case modalities if possible (eg, open, lap, endourologic) ✓ Vary case types and lengths (eg, avoid 8 URSs in a row) ✓ In academic centers, while resident is operating, sit or vary posture (and vice versa) ✓ Alternate surgical days with clinic and administrative time when feasible

Abbreviations: lap: laparoscopic; OR: operating room; PCNL: percutaneous nephrolithotomy; URS: ureteroscopy.

procedures as transurethral prostatic and bladder procedures, ureteroscopy, and percutaneous nephrolithotomy (PCNL). The ergonomics of open, laparoscopic, and robotic-assisted laparoscopic urology are outside the scope of this Update.

ENDOUROLOGIC RISKS

For decades, endourological procedures were performed using direct endoscopy, in which the urologist looked directly through the endoscope without the use of a video monitor. Direct endoscopy forced surgeons into ergonomically unfavorable postures. Today, endoscopic surgery is almost exclusively performed with the assistance of cameras and remote video monitors. Another advance in modern OR design was the arrival of ceiling-mounted monitors that can be easily positioned to align the visual-motor axis during both standing and seated procedures.[19] Despite these innovations, high rates of MSK pain and injury persist in the endourology community.[9,10]

We will consider 3 categories of ergonomic factors that can limit pain/injury associated with endoscopic surgery: environmental/OR factors, surgeon-specific factors, and device design factors.

Environmental and OR factors

Monitor Positioning: The relationship between the scope, the monitor, and the surgeon's viewing direction form the visual-motor axis. **The optimal monitor position to align the visual-motor axis during endoscopic surgery is directly in front of the surgeon, between 80 and 120 cm (2.5-4 ft) away, and at a height that limits forward neck flexion to < 25° (Figure 1).**[20,21] Placing the monitor perpendicular to the surgeon at about an arm's length away with the top of the screen at eye level is a useful approximation. At this monitor position, surgeons experience reduced eyestrain (as the orbital musculature is in its most relaxed state at this distance) and

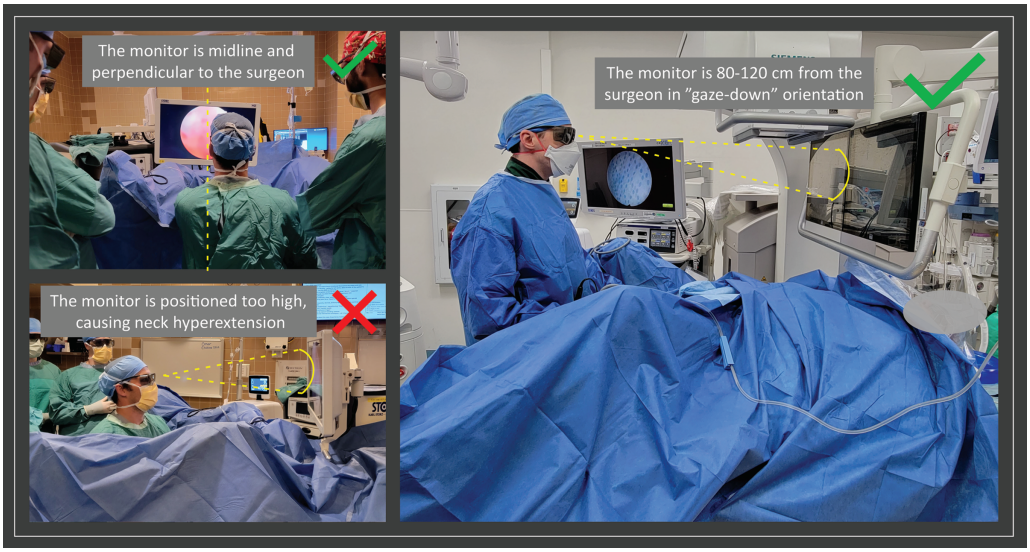


Figure 1. Optimal monitor position, distance, and viewing angle during sitting and standing endoscopic surgery.

improved electromyographic parameters in neck and shoulder musculature.[20,22] Although a C-arm may obstruct the view of a properly placed monitor, this can be circumvented by use of a ceiling-mounted monitor or undocking the C-arm from over the patient after access has been obtained. While operating in the seated position, lowering the patient's leg on the ipsilateral side may allow the surgeon to view the monitor at eye level. **Excessive neck flexion can be particularly detrimental–for every inch that the head is held forward, an additional 4.5 kg (10 lb) of weight is exerted on the cervical spine.**[5] Importantly, monitor position is associated with surgeon operative efficiency, as multiple randomized controlled trials have demonstrated improved economy of motion, better task performance, and reduced operative time when appropriate monitor positions are adopted.[21,23,24] These data underscore the importance of cross talk between surgeons, ergonomists, and architects who design OR spaces.

Table Height: The optimal table height for endoscopic surgery will vary depending on surgeon anthropometrics, the procedure being performed, and whether a fluoroscopy table or C-arm is being utilized, as well as whether the surgeon is operating from a sitting or standing position.

When operating from a standing position, ergonomists suggest the target working area (where the hand is performing work) should be 50 to 100 mm (2-4 in) below elbow height.[25] Therefore, many abdominal surgeons adjust the table so the patient's abdomen is approximately at elbow height before the incision is made, so that the target working area will be several inches below elbow height once the abdomen is open. In contrast, the target working area in endoscopy (site where instruments enter the body) is similar to laparoscopy and slightly lower than in open surgery. **Adapting ergonomic guidelines set forth for laparoscopic surgery, the table height during endoscopic surgery should be set such that the target working area (eg, urethral meatus, ureteral or percutaneous access sheath) is roughly between the level of the surgeon's pubic symphysis and umbilicus while standing.**[20] The surgeon should stand far enough away from the patient that there is no redundancy in the scope. The dominant hand should hold the scope with the nondominant hand at the urethral meatus to allow for both micro- and macromovements of the endoscope.[26] The ideal table height is surgeon specific, and thus surgeons should adjust the table when switching roles (eg, attending switching with resident) during a case. If the surgeon is operating in a seated position, the table height should be adjusted so the surgeon is able to sit comfortably with their feet flat on the floor with knees at roughly a 90° angle while still able to manipulate the scope without abducting their shoulders.[27] Depending on whether the surgeon is utilizing a C-arm or designated fluoroscopy table, a seated position may necessitate changes to monitor position that promote neck hyperextension. Although one study evaluating rates of pain among those performing ureteroscopy found no difference in pain metrics between sitting vs standing position, further study is needed.[9] Modified ergonomic lithotripsy is another strategy that adjusts the patient's body position to optimize ergonomics for the surgeon. After placement of an access sheath, the patient is placed in 35% inclined lithotomy, which allows the surgeon to remain seated during the procedure.[26] Arm rests can be utilized to prevent fatigue if needed.

If more than 1 surgeon is operating concurrently (such as during PCNL), the height should be set according to the tallest individual and the other(s) should use stepstools.[28] Ideally, stepstools should be broad based to improve stability. Limit stacking large numbers of stepstools if possible to reduce the risk of falling. For procedures in the lithotomy position, table height should be adjusted for the surgeon holding the scope. In such procedures, bed height is not a large determinant of the assistant surgeon's postures, as their intraoperative tasks and movements are often away from the operative site.

Adjunct Equipment: **A prospective, randomized, controlled trial comparing gel mat vs none during ureteroscopy and PCNL found that gel mats improve surgeon postoperative discomfort and energy.**[29] For cases > 60 minutes in duration, gel mats also decreased the number of stretches and postural changes from discomfort.[29] A similar randomized controlled trial found benefits of using antifatigue mats among scrub nurses.[30]

Thoughtful positioning of foot pedals can improve surgeon posture. When operating from a standing position, the surgeon

must frequently shift their balance such that most of their body weight is placed on the foot that is not engaging the foot pedal. **Recommendations for optimal use of foot pedals include limiting dorsiflexion of the foot above the pedal to < 25°, positioning the pedal in line with the direction of work, locking the foot pedal in place to avoid shifting during the procedure, and utilizing shoes with a maximal external width < 108 mm to minimize risk of accidental engagement of other pedals.**[31]

Surgeon factors

Surgeon Posture in the OR: The interactions between surgical team members and their working environment greatly influence their resulting postures, so environmental factors should always be optimized first (as described above) within the constraints of the available equipment. **For example, at the beginning of a case, table height should be optimized, and foot pedals placed in line with the surgeon's torso**. **Monitors should be adjusted horizontally to minimize trunk or neck rotation and vertically to allow the user to gaze down, thus minimizing eye and neck strain.** Making such equipment adjustments before starting the case optimizes the environment and decreases the frequency of high-risk intraoperative postures. However, environmental optimization alone is not enough to prevent the awkward positions and static postures that are commonly noted during endourologic procedures. In general, routine scope handling technique should be performed with ergonomics in mind, recognizing that when challenging anatomy is encountered awkward positions might be required but static maintenance of such positions should be minimized. **In addition, it is helpful to recognize (and resist) the unconscious tendency to tilt or rotate the head while maneuvering the scope around corners, since head movement will not improve visualization on a 2-dimensional video monitor. During flexible cystoscopy and ureteroscopy, the scope should be held close to the surgeon's chest near the midline with a more acute elbow angle than used in rigid scope procedures.** The scope should be held with the fingers, rather than using the entire hand/palm.[26]

Urologists should also make sure they understand how to safely transfer patients on and off the OR table. The Association of Perioperative Registered Nurses has developed algorithms for both supine and prone patient transfers that use case-specific data to determine the minimum number of caregivers required to safely transfer and whether assisted transfer devices are needed.[32]

Corrective Lenses Can Affect Surgeon Ergonomics: Accurate vision is critical for high-quality surgical performance, but corrective lenses can increase the frequency of high-risk ergonomic postures. Less than a decade into independent practice, most urologists will experience normal age-related presbyopia.[33] Many will require corrective lenses to regain adequate near vision required to perform surgery. Those who already wear glasses will often transition to bifocals, trifocals, or progressive lenses. Most opticians have customers choose glasses based on aesthetics and then design a lens that is adequate for the "average" consumer, without considering their profession. **For surgeons, bifocals, trifocals, or progressives can create new work-related ergonomic challenges or compound existing ones.** The need to consistently look through the inferiormost portion of eyeglasses can lead to excessive neck extension and/or long periods of time in static neck positions as they attempt to maintain line of sight through a narrow section of the lens. **Surgeons should be aware of several characteristics of corrective lenses that influence workplace ergonomics, including the size of the frame/lens, whether the frames have eye pads (which render them more adjustable), and the location of the transitions between prescription zones.** Endourologists should consider corrective lenses (or goggles) adapted for work that only correct for near and intermediate vision (sometimes referred to as "workspace" lenses). Surgeons should work with their optometrist or ophthalmologist to find the correct working distance that is needed. In endourology, near vision is important for precise threading of wires into catheters while intermediate vision allows accurate assessment of video and fluoroscopic images. **Well-designed workspace glasses can help ameliorate ergonomic strain by increasing the surface area of the lens used during work tasks (reducing static neck postures) and raising the location of the transitions between prescription zones (minimizing neck extension)**.

Device factors. Arguably just as important as the postural and OR setup considerations is the human-machine interface with the devices surgeons employ.[34,35] Unlike environmental or surgeon-specific ergonomic factors, surgeons may be limited in their ability to modify which devices are supplied by their health care system. Nonetheless, a good working knowledge of device considerations may aid in crafting case preference cards and inform advocacy efforts by surgeons to administration to prioritize purchasing ergonomic equipment.

Scope Design: The choice of cystoscope, ureteroscope, and nephroscope influences MSK strain and ease of use. **Differences in scope material and weight can impact the forces required to achieve similar degrees of deflection, which affects the degree of wrist and thumb strain.**[7,35] Additionally, ureteroscopes that utilize intuitive deflection (up is up, down is down) have been shown to cause less MSK pain when compared to surgeons using scopes with counterintuitive deflection (up is down, down is up).[36] **Digital and single-use ureteroscopes tend to be lighter and easier to flex, which decreases activation in upper extremity muscle groups on electromyogram.**[7,37] Single-use scopes are ~100 g lighter than digital scopes.[34] Digital ureteroscopes are lighter than their fiberoptic counterparts (310-350 vs 300-950 g) after considering the additional weight of the camera head (266-798 g).[7,34] Despite the lighter build and easier flexion with certain scopes, survey studies among endourologists found equal utilization among reusable digital ureteroscopes, reusable fiberoptic ureteroscopes with attachable camera head, or single-use ureteroscopes.[9] Many hospital systems may only offer 1 scope option, thereby limiting comparisons.

Robotic-Assisted Ureteroscopy and Cystoscopy: Although in its infancy, robotic-assisted ureteroscopy has emerged as a means of lowering the learning curve to performing fURS and improving ergonomics. **These devices offer several advantages over conventional ureteroscopy including**

3D visualization, syncing movements with respiratory variation, and wrist-like articulation that spares the surgeon from having to contort their wrist and hand throughout the case.[38] Clinical trials demonstrated that the robotic-assisted fURS might offer safety, efficacy, and ergonomic superiority (improved degrees of freedom in wrist movements, motion-scaling, and subjective improvements in pain scores) over conventional ureteroscopy.[39] Robotic-assisted rigid cystoscopy such as Virtuoso Surgical's endoscopic surgical system delivers 2 robotically controlled, needle-sized manipulators that work from the tip of a rigid endoscope and allow precise movements for en bloc resections and enucleations, all using a game controller.[40]

Laser Technology, Access Sheaths, and Irrigation Systems: Advances in laser technology may improve efficiency during lithotripsy and ablative procedures, and thereby reduce time spent in high-risk body positions. The advent of technologies that reduce retropulsion and improve efficiency of energy delivery may also obviate the need to chase after stone fragments. The use of access sheaths allows for improved irrigation and enhanced visibility. Automatic pressure-regulating irrigation pumps combine the benefits of maintaining safe irrigation pressures while maintaining adequate visibility.[41] Unfortunately, most ORs instead rely on gravity irrigation or manual-assisted irrigation. Manual irrigation systems that require human input necessitate additional surgeon or assistant effort during the procedure and may impede efficiency as well as contribute to repetitive motion fatigue in the hands/wrists or feet.

PREVENTION STRATEGIES

Prevention begins with the environmental adjustments that occur even before scrubbing in. Well-trained OR teams can optimize environmental ergonomics for endourological cases, allowing the surgeon to focus on the case. Urologists should confirm the correct room setup and direct final adjustments to the table and monitor heights. They should be aware of high-risk postures and have a plan for reducing the frequency and time spent in such postures. **"Postural resets" are an intraoperative technique that can be used by surgeons and scrubs to stay mindful of their body positioning and reset to a less risky position as needed.**[42] However, operating surgeons who are "in the zone" are often unaware they are in high-risk body postures, so other team members should be encouraged to remind them to adjust.

Sitting for cases which involve significant foot pedal use (transurethral resection of the prostate, transurethral resection of bladder tumor, holmium laser enucleation of the prostate) prevents long periods of weight bearing on the nondominant leg.[5] **If case types and equipment are amenable, alternating between sitting and standing cases can also reduce MSK strain.** However, radiation exposure can vary with sitting and standing, depending on the fluoroscopy source. Radiation doses are higher below the table when using a C-arm and above the table when using a fluoroscopic bed.

Shoes with arch support as well as pressure hosiery can also help improve/prevent foot and leg discomfort.[43] **Weight increases ergonomic risk by increasing muscle load, so surgeons can decrease weight by utilizing the lightest scopes, lead, and eyewear (laser and/or radiation glasses) available.**[44] **Wearing an appropriately sized 2-piece lead (skirt and vest) distributes the weight of the lead, reducing direct pressure on the shoulders, and might decrease low back pain.**[45]

Stretching and exercise. Intermittent intraoperative stretches in cases > 2 hours have been shown in small trials to improve subjective ratings of surgeon pain and mental focus pain without increasing case time (Appendix).[18,46] **However, the majority of endourology cases are < 2 hours, so endourologists might derive greater benefit from stretching between cases (https://youtu.be/bLAeVbBjZV0).** Consistent use of pre- and postoperative exercises and stretches targeting the neck, shoulder, and back was found to have benefit in a randomized trial after 6 months (Figure 2).[47] For endourologists who perform long cases, intraoperative microbreaks ("OR stretch") have been integrated into a web-based app that provides regular reminders to stretch and is available free of charge at https://orstretch.mayoclinic.org/.[46] In a large international survey of urologists, exercise (outside the OR) was correlated in a dose-dependent fashion with reductions in work-related pain.[3] Individualized on-the-job ergonomic assessment and instruction by a physical therapist was found to improve discomfort in a small study of gastrointestinal endoscopists.[48] Neck and shoulder exercises were found to improve symptoms in industrial workers but have not been studied in surgeons.[49] Targeted massage and physical therapy can also help improve pain (therapeutic) and maintain flexibility (preventive). One recent publication proposes a surgeon-specific fitness routine that only takes 12 minutes 3 to 5 days per week.[50] These exercises can be employed at any location, without equipment, and include elements of stretches, cardiovascular exercise, and strength training.[50]

Implementation and workflow integration. A general understanding of ergonomic principles combined with the knowledge of prevention strategies is, on its own, rarely effective in motivating sustained integration of healthy ergonomic practices into surgical workflow. While in the OR, urologists are occupied with the needs of the patient and with satisfying a myriad of institutional and regulatory requirements. Minimal bandwidth remains to address their ergonomics and that of their teams. **Creative strategies are needed to implement data-driven injury-prevention interventions into local workflows.** Many institutions have detailed case cards for each surgeon that describe their preferred instruments, disposables, room setup, and patient positioning. **These cards can be augmented with ergonomic instructions such as intraoperative microbreak intervals and stretching instructions. Another strategy, known as habit stacking, is to link a new habit (postural recheck, intraoperative stretch break) to an old habit (or predictable activity), such as the time-out or a predictable step during surgery.** Teams could agree to always stretch while they wait for the prep to dry, or once the drapes come off at the end of a short procedure, or during debriefing. Over 80% of participants in a large cross-sectional survey of urologists stated they would consider incorporating an ergonomics component to the traditional surgical time-out.[9] Both patient and surgeon safety should be prioritized during the briefing/surgical time-out, and this could be an efficient

Figure 2. Targeted stretching routine for perioperative use. Figures adapted from Lia Araburu through Vecteezy.com. Stretching routine adapted from Giagio S et al, *A Preventive Program for Work-Related Musculoskeletal Disorders Among Surgeons: Outcomes of a Randomized Controlled Clinical Trial*. Lippincott Williams & Wilkins; 2019.[47]

means of operationalizing strategies to reduce ergonomic risk factors in the OR. Further research on how best to identify and share successful implementation of prevention strategies is needed, as each institution differs in its work processes and culture.

Workstation optimization. In addition to the risks of the OR, urologists spend significant time at their computers, which can exacerbate MSK pain, as most desks are too high. Urologists should use an adjustable chair with lumbar support, knees at 90°, and feet on the floor (or a footrest).[27] Elbow angle should be 90° with wrists straight, not resting on the desk. The top of the monitor should be at or slightly below eye level, so the user gaze is ~20° down and the screen is 50 to 100 cm (20-40 in) away (Figure 3). Bifocal wearers should drop the monitor an additional 1 to 2 in. Proper ergonomic positioning is almost impossible when using a laptop without a separate monitor (or a riser) and separate keyboard.

Figure 3. Recommendations for computer workstation ergonomics. Used with permission of Mayo Foundation for Medical Education and Research, all rights reserved.

CONCLUSIONS

The optimization of environmental, surgeon-specific, and equipment/device factors can improve the safety of the procedure for both patient and surgeon. It is important to recognize that implementing ergonomic best practices is a team effort, involving not only the surgeon, but also the nursing staff and other members of the OR team. By working together and considering ergonomics at every stage of the procedure, health care professionals can ensure that endourology procedures are performed with maximum efficiency and minimal risk of injury to all involved.

DISCLAIMER

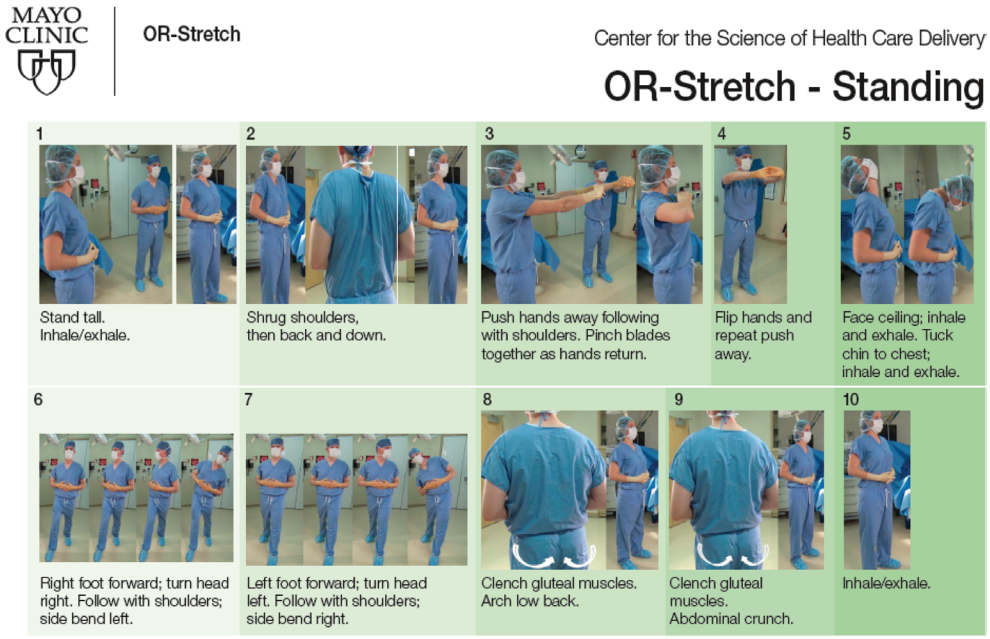
The contents of this publication do not represent the views of the US Department of Veterans Affairs or the US government.

DID YOU KNOW?

- Work-related MSK pain and injury are highly prevalent among endourologists and can be attributed to both modifiable and nonmodifiable factors.
- Nonmodifiable risk factors for MSK pain include age, gender, and inexperience.
- One of the most important modifiable risk factors is body posture, which can be influenced by environmental, personal, and equipment factors.
- Environmental factors that can affect body posture include monitor position, table height, patient positioning, and adjunct equipment (eg, antifatigue mats).
- Surgeons can avoid MSK injury by being aware of high-risk postures, engaging in targeted stretching routines (both intraoperative and perioperative), and seeking out light and supportive adjunct equipment (eg, lead, glasses, scopes).

APPENDIX

OR stretch–standing. From: Mayo Clinic Patient Education. Center for the Science of Healthcare Delivery Operating Room Stretches - Standing (MC7088-33rev0519). Rochester, MN: Mayo Clinic, 2018; used with permission of Mayo Foundation for Medical Education and Research, all rights reserved.



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Study Questions Volume 42 Lesson 38

1. What are the most common sites of musculoskeletal pain among endourologists performing endoscopic surgery?
   a. Upper back
   b. Elbows and shoulders
   c. Neck, hands, and wrist
   d. Lower back

2. Which of the following actions helps optimize ergonomics during flexible ureteroscopy?
   a. Adjusting monitors in the vertical plane to minimize trunk or neck axial rotation
   b. Adjusting monitors in the horizontal plane to allow the user to "gaze down"
   c. Tilting or rotating the head while maneuvering the scope to improve visualization around the corner
   d. Holding the scope close to the chest with an acute elbow angle (between forearm and bicep)

3. Which of the following is a potential ergonomic challenge for surgeons who wear corrective lenses for presbyopia?
   a. Using multiple video monitors during a case
   b. Need to wear laser goggles over their corrective lenses
   c. Neck flexion when attempting to maintain line of sight through a narrow section of their corrective lenses
   d. Neck extension when attempting to maintain line of sight through a narrow section of their corrective lenses

4. Which of the following behaviors can surgeons use to prevent foot and leg discomfort during endourological cases?
   a. Operating from a standing position
   b. Using the lightest scopes available
   c. Wearing a one-piece lead
   d. Using pressure hosiery

5. Which injury-prevention strategy has demonstrated meaningful benefit by improving surgeon pain in published trials?
   a. Regular intraoperative stretching routines
   b. Wearing two-piece rather than one-piece lead aprons
   c. Using digital rather than fiberoptic scopes
   d. Using holmium rather than thulium laser fibers