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Presbyopia in surgeons: ergonomic impact and tips for management

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Running Head: Surgeon presbyopia management and ergonomics

Work-related musculoskeletal pain in surgeons is common and often due to awkward and/or static postures.[1] Unfortunately, since the majority of surgeons will develop presbyopia by the age of 50, corrective lenses intended to improve visual acuity can promote postures that increase the risk of pain and injury.[2, 3]

Improved understanding of both presbyopia treatment options and optimal intraoperative postures can assist both surgeons and their eyecare providers in choosing and designing an individualized presbyopia management plan. Our novel assessment tool for presbyopic surgeons (Fig 1) captures the various working/viewing distances required for different surgical techniques. Eyewear can then be designed with the surgeon's individual workspace in mind to simultaneously correct changes in visual acuity while preventing work-related musculoskeletal injuries.

Optimal surgical ergonomics

We will focus here on the ergonomics of the head/neck/upper back as they are most relevant to assessment of the working/viewing distances required for presbyopia management. There are several excellent reviews on surgical ergonomics that address the topic more broadly.[1, 4, 5] In general, posture should be as upright as possible and long periods in static positions should be avoided. During open surgical procedures, excessive neck and back flexion are common. Neck flexion >30 degrees increases the risk of neck injury/pain and is exacerbated by the extra weight of loupes and headlamps.[6] During laparoscopic and endoscopic procedures, surgical monitors are often positioned too high, leading to excessive neck extension. To optimize ergonomics, surgical monitors should be adjusted so that the user maintains a "gaze down" position with the line of sight directed approximately 20 degrees down from horizontal, thus minimizing eye muscle strain. A simple rule of thumb is to adjust the top of the display to eye level which facilitates "gaze down" position when focused on the center of the screen. The monitor should align with the surgeon's torso and the target working area and should be approximately 3 feet (arm's length) from the user, although larger screens can be placed further away. When completing the assessment tool for presbyopic surgeons (Fig 1), record the working/view distances while your neck/back are ergonomically optimized as described above.

Presbyopia Treatment Options

Understanding options for presbyopia treatment and their ergonomic implications can empower surgeons to simultaneously optimize their vision and intraoperative ergonomics. Pharmacologic and surgical correction for presbyopia are rarely used and outside the scope of this paper.

Glasses

Bifocals contain two lens powers separated by a visible line. The upper portion of the lens is designed for distance vision, while the lower portion has a smaller segment for near vision. Trifocals have three segments with the addition of an intermediate segment for viewing objects at arms' length. Progressive lenses provide a smooth and gradual transition between the top (for

distance vision) to the bottom (for near vision) of the lens. This design allows for correction at all distances, including intermediate vision, without any visible lines or segments on the lens. Due to the optical design, these lenses have areas of distortion and blur in the periphery.[7] Therefore, to maintain visual acuity when looking laterally requires head movement rather than eye movement. Surgeons will be able to visualize the surgical monitors using the intermediate zone of their corrective lenses. However, the challenge lies in sustaining their line of sight through a limited area on the lens, which can lead to static postures and neck hyperextension, both of which increase the risk of musculoskeletal pain and neck injury.

Computer glasses, or workspace glasses, are designed to optimize visual clarity when viewing objects at specific intermediate and near distances. They often provide a wider range of clear vision compared to progressive lenses. This feature allows the users to comfortably view the entire computer screen without the need to constantly adjust their focus, thereby reducing eye strain.[8] These glasses can be designed to provide surgeons with excellent visual acuity, both when manipulating instruments through the scope or ports (near vision) as well when viewing the surgical monitor (intermediate vision).

Over-the-counter single vision reading glasses are pre-made glasses available without a prescription (aka “readers”). Typically ranging in magnification from +1.00 to +4.00, these are commonly utilized at much closer distances of 11 to 16 inches. The magnification power indicates how much additional focusing power the lenses provide for near vision.

Depending on the surgical techniques utilized, the working and viewing distances required, and the amount of time spent at a computer workstation, some surgeons might find they need both surgery/computer specific glasses as well as a more “generic” version for general use and driving.

Contact Lenses

Contact lenses for distance vision can be worn in addition to single vision reading glasses. This provides the simplest solution for existing contact lens wearers to improve near vision once they develop presbyopia. Alternatively, monovision contact lenses manage presbyopia by correcting one eye for distance (usually the dominant eye) while the other eye is corrected for near vision, allowing for vision over a wide range of distances. There is some loss of stereoacuity (three-dimensional perception) which occurs as the power needed for reading increases.[9] Therefore, this option has obvious drawbacks for many surgeons who rely on three-dimensional vision intraoperatively. Multifocal contact lenses are designed with different zones or rings that correct vision at different viewing distances while creating a seamless transition between them.

Uncorrected Presbyopia

Presbyopic surgeons operating without corrective lenses or contacts can have difficulty performing surgical tasks that require near vision. This is compounded by the fact that laparoscopic and endoscopic cases are usually performed with the room lights dimmed, which further degrades visual acuity.

Conclusion

For most surgeons, presbyopia is inevitable, and it is important to understand the visual and ergonomic implications. Our assessment tool for presbyopic surgeons is designed to provide clear communication between surgeons and their eyecare providers, especially regarding the visual challenges of diverse surgical practices. Our goal is to facilitate the choice and design of an individualized presbyopia management plan that will optimize both visual acuity and surgical ergonomics.

Future studies should assess whether use of our assessment tool for presbyopic surgeons (Fig 1) is feasible and if so, whether it changes management plans versus surgeons who obtain standard presbyopia treatment. Although there is evidence supporting optimal presbyopia management, future work should assess whether this approach to surgeon presbyopia management decreases time spent in awkward neck postures (as measured by rapid upper limb assessment (RULA) scores), whether it decreases strain in the cervical musculature (as measured by electromyography), and whether it improves validated measures of eye strain and neck pain.

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Figure 1 Assessment Tool for Presbyopic Surgeons

Assessment Tool for Presbyopic Surgeons

Please provide this information to your eyecare provider to assist them in designing your individualized presbyopia management plan.

Name:_____ Age _____

I currently wear the following for vision correction (check all that apply)

- ☐ Single vision glasses
- ☐ Bifocal/Trifocal glasses
- ☐ Progressive glasses
- ☐ Specific workplace glasses
- ☐ Single vision contact lenses
- ☐ Monovision contact lenses
- ☐ Multifocal contact lenses
- ☐ Reading glasses over contacts

During surgeries I experience the following visual difficulties (check all that apply)

- ☐ Difficulty seeing fine details
- ☐ Blurred vision at a specific distance (close-up or distance vision)
- ☐ Eyestrain or fatigue
- ☐ Headaches or eye discomfort
- ☐ None

To avoid work related neck discomfort or blurry vision that can result from using bi/trifocals or progressive lenses during surgery, you might require more than one pair of corrective lenses. The measurements below will be used by your optometrist/optician to assist you in determining your individualized needs.

Note: Please measure all distances while in a comfortable neutral body position (avoid significant neck or back flexion)

I would like visual correction for the following settings (check all that apply)

- ☐ Home office Distance from eyes to monitor=_____cm ("A" in Illustration 1)
- ☐ Work office Distance from eyes to monitor=_____cm ("A" in Illustration 1)
- ☐ Clinic Workstation Distance from eyes to monitor =_____cm ("A" in Illustration 1)
- ☐ Reading (enter measurements below)
- ☐ Surgery (enter measurements below)

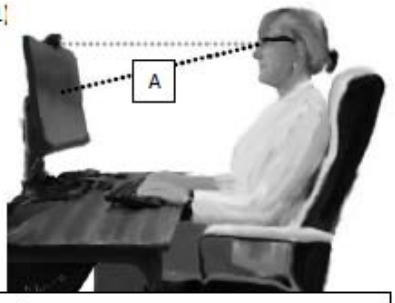

Illustration 1 Ergonomic Workstation Positioning

Reading:

Distance from eyes to book=_____cm ☐ I read mostly books

Distance from eyes to smart phone=_____cm ☐ I read mostly on my phone

Distance from eyes to tablet/ipad=_____cm ☐ I read mostly on my tablet

Surgery:

I use the following surgical techniques/modalities (check all that apply)

☐ Open Surgery, distance from eyes to target working area=_____ cm (see "B" in Illustration 2)
[Average hrs/week=___]
☐ I usually use loupes for open surgery

☐ Robotic surgery (w/lap port placement)
[Average hrs/week=___]

☐ Microscopic surgery (w/ surgical microscope)
[Average hrs/week=___]

☐ Endoscopic Surgery, distance from eyes to surgical monitor=_____ cm
[Average hrs/week=___]

☐ Laparoscopic surgery, distance from eyes to surgical monitor=_____cm (see "C" Illustration 3)
[Average hrs/week=___]

Illustration 2 Open Surgery Positioning

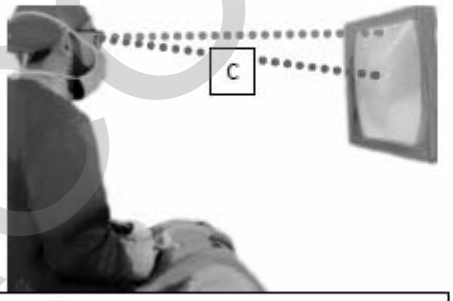

Illustration 3 Laparoscopic Surgery Positioning