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# Ergonomics of Ophthalmic Surgery: Evaluating the Effect of a Posture Trainer on Trainee Intraoperative Back Posture

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## Abstract

**Purpose** Ophthalmic surgeons are at an increased risk for musculoskeletal disorders resulting from ophthalmology-specific routines and equipment, which have become widely associated with poor posture. The purpose of this study was to observe the effect that a commercially available posture trainer, Upright Go, can have on the improvement of posture of ophthalmic surgeons.

**Methods** Eight ophthalmologists-in-training were studied over a period of 4 weeks during their surgical rotations between September 2020 and June 2021. Participants underwent an "observation" period, followed by a 2-week "training" period, then a final "testing" period. The percentage of time users spent upright intraoperatively pre- and posttraining was evaluated. Pre- and poststudy surveys were also administered to help measure participant satisfaction and self-reported changes in posture.

**Results** All eight participants demonstrated an increase in the percentage of time spent upright after the training period. Across all participants, the total average percentage spent upright in the observation period was 59.8%, while in the testing period was 87.1%, resulting in an average improvement of 27.3% of time spent in an upright position after the completion of the training period ($p < 0.0001$). The range of improvement of time spent upright was 16.0 to 46.5%.

**Conclusion** This cohort study utilized the Upright Go device to help determine the effect that its training could have on the improvement of posture in ophthalmic surgeons. The results indicated a significant increase in the average proportion of time spent with upright posture compared after the training period.

**Keywords**
- posture
- posture training
- intraoperative
- ergonomics
- ophthalmic surgery
- back posture

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Ophthalmologists are at a significantly higher risk for work-related musculoskeletal disorders (MSDs) compared with nonsurgical physicians due to the dexterous, lengthy nature of microsurgeries.[1–6] The repetitive movements and sustained contractions experienced while operating slit lamp biomicroscopes, loupes, and indirect ophthalmoscopes impart increased postural stress in up to 87% of surveyed ophthalmic surgeons.[1,2,4,5,7,8] The subsequent pain and discomfort can affect not only the surgeon's health, but also that of their patients.[8] As the risk of these irreversible postural changes can increase over time, early intervention is crucial.[2,3]

Our study, therefore, aims to target and prevent these potentially adverse outcomes by offering an ergonomic solution for ophthalmic surgeons, as prior studies have begun to explore via posture training.[5] The Upright Go is a portable device that can be positioned on the individual's back to deliver real-time haptic feedback to a smartphone based on back posture. In this pilot study, we evaluated the effect of this device on the back posture of ophthalmologists-in-training in hopes of teaching good habits to reduce work-related injuries and their long-term consequences.

## Methods

This prospective cohort study was approved by the Institutional Review Board at the University of Miami and adhered to the tenets of the Declaration of Helsinki. Eight ophthalmologists-in-training were included in the study and followed over a period of 4 weeks between September 2020 and June 2021. Subjects first received a presurvey regarding back pain and their back posture. Pre- and postsurveys were adapted from the previously validated Nordic Musculoskeletal Questionnaire.[9] They then underwent an "observation" period consisting of two surgical days during which their postural data was tracked via the posture training device and recorded through an associated phone application. The trainees then entered a 2-week "training" period during which the device was calibrated and programmed to vibrate anytime the user slouched past 90 degrees based on the individualized calibration of each user. The final "testing" period consisted of another two surgical days while user posture was again tracked without vibration. After, each participant completed a postsurvey self-evaluation with participant perspective of self-improvement. Statistical analyses including paired *t*-tests, correlations, and other frequency outcomes were calculated.

## Results

The study population (5 females [62.5%] and 3 males [37.5%]) included 6 (75.0%) second- and third-year residents and 2 (25.0%) fellows on different surgical rotations at the time of participation. The participants self-reported an average of 60.3 work hours per week, of which an average of 12.6 were spent operating. The group reported exercising, on average, 2.9 days a week.

Prior to training, survey data measuring self-reported surgical posture on a Likert scale (1 = strongly disagree, 5 = strongly agree), revealed participant awareness of poor posture (►**Table 1**). Intensity of back and neck pain, reported at an average of 7.4 and 7 out of 10, respectively, were significantly correlated with the number of years spent in ophthalmologic training ($p < 0.01$). Reported pretraining back and neck discomfort shared significant, inverse relationships with both the percentage of time spent upright prior to training as well as number of days spent exercising per week ($p < 0.01$). All participants ($n = 3$) who exercised less than 3 days a week, on average, conveyed a pretraining back pain score of 8 or above. The average pain score of those who exercised more often was 6.6 out of 10. One participant reported undergoing ergonomic training previously.

After undergoing training, all eight participants demonstrated an increase in the percentage of time spent upright (►**Fig. 1**). Across all participants, the total average percentage spent upright in the observation period was 59.8%, while in the

**Table 1** Average responses to postural pre- and poststudy survey questions

| Question<br>In the operating room, do you: | Average participant response (1 = strongly disagree, 5 = strongly agree) | | |
|---|---|---|---|
| | Prestudy | Poststudy | *p*-Values |
| Sit with your back well supported on the backrest | 2 | 2.5 | 0.44 |
| Sit with your upper body twisted (with torso torsion) | 2.8 | 2.3 | 0.51 |
| Sit with both feet firmly on the floor | 3.1 | 3.8 | 0.39 |
| Stand with equal support on both legs | 3.6 | 3.8 | 0.77 |
| Change body position frequently to get back comfortable | 3.9 | 3.7 | 0.67 |
| Carry out body movements (e.g., joint movements, stretching, etc.) | 3.9 | 3.8 | 0.94 |
| **While in the operating room, have you experienced:** | **Average participant response (1 = no pain, 10 = extreme pain)** | | |
| | **Prestudy** | **Poststudy** | ***p*-Values** |
| Neck pain | 7.0 | 5.2 | 0.33 |
| Back pain | 7.4 | 5.8 | 0.39 |

Note: Summarizes the average responses to postural pre- and poststudy survey questions completed by all eight participants in the study.

 

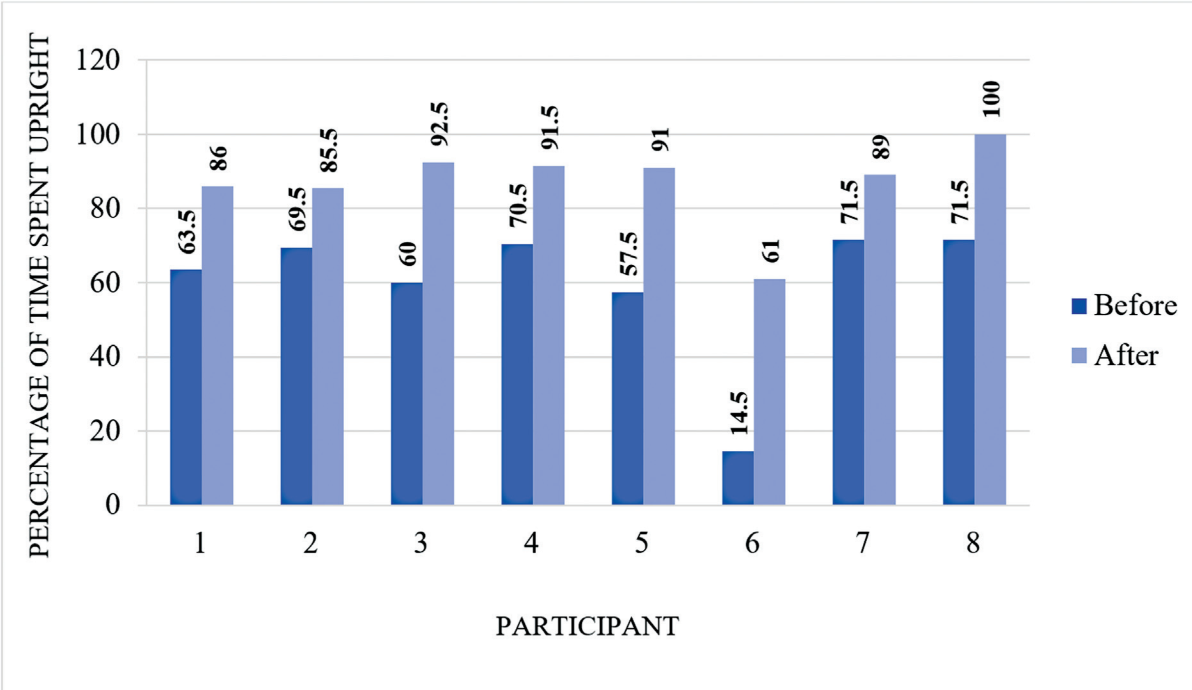


**Fig. 1** Percent of time each participant spent upright before and after posture training, indicating that all eight patients demonstrated improvement in posture after using the posture trainer.

testing period was 87.1%, resulting in an average improvement of 27.3% of time spent in an upright position after the completion of the training period ($p < 0.0001$). The range of improvement of time spent upright was 16.0 to 46.5%.

The administered postsurvey questionnaire revealed a nonsignificant self-reported average improvement in both back pain (3.5) and back discomfort (3.5) among participants (Likert scale, 1 = strongly disagree, 5 = strongly agree). Survey data also revealed a 20.9% improvement in average self-reported back discomfort and 26.2% in average neck discomfort, although neither result achieved statistical significance (►**Table 1**).

## Discussion

This study's findings demonstrate that all participants demonstrated an increase in the percentage of time spent upright after using the posture trainer. While embodying perfect posture 100% of the time should be every surgeon's goal, it is important to identify strategies that at least increase the amount of time spent practicing upright positioning relative to his or her own baseline. Ophthalmologic surgeons, especially those in training, have reportedly faced a variety of ergonomic challenges in the operating room, leading to increased work-related MSDs.[1,5] These chronic, adverse outcomes can result in significant disability, which often remain underreported due to lack of ergonomic awareness and training.[5] The potential injuries that may ensue can affect career longevity and be considered health care expenditure waste due to an existing shortage in the surgical workforce.[1,8]

This cohort study, therefore, utilized the Upright Go device to help determine the effect that its training could have on the improvement of posture in ophthalmic surgeons. Our results showed that, prior to training, participants with worse posture experienced more discomfort, reflected in a statistically significant relationship between pretraining back and neck discomfort and percentage of time spent upright ($p < 0.01$). The level of baseline back discomfort was also significantly related to the number of years spent in ophthalmology training ($p < 0.01$), which is supported by the literature.[1,5]

While only one of our participants had experienced ergonomic training before participating, prior research states that usage of a posture trainer is correlated with prevention of work-related MSDs.[2] Our results showed that each participant demonstrated improved posture after being trained with such a device, with the average overall increase in time spent upright increasing by over 25%. Participants also reported improvement in back pain and discomfort as well as a quantitative reduction in back and neck pain intensity after having undergone posture training.

Exercise has also proven to be inversely correlated with MSDs in ophthalmology.[2] A study by Sivak-Callcott et al demonstrated reduced likelihood of injury in oculoplastic surgeons who exercised over 5 hours weekly[10]; others have reported reduced neck/shoulder symptoms in those that exercise at least three times weekly.[6] Our data supports this by stating that 100% of participants who exercised less than 3 days a week reported extreme back pain, measured by a score of 8 out of 10 or higher. Reported pretraining back and neck discomfort proved to share a significant relationship with number of days spent exercising per week ($p < 0.01$).

Changes in the workplace can also reduce the onset of MSDs. Studies show that reduction of loupe and headlamp usage, stretch breaks at 45-minute intervals, and operating chairs with chest support are examples of successful modifications.[7] Our participants did not utilize chest-supporting stools during this study, potentially leading to the high average (3.9, 1 = strongly disagree, 5 = strongly agree) self-reported frequency of body repositioning (►**Table 1**).

While this study is limited by a smaller sample size, which may offer reduced ability to statistically capture significant differences especially in the context of the Nordic survey, the technology allowed by haptic devices makes it more feasible than ever to conduct posture observation and training inexpensively and efficiently on a larger scale. Another limitation to consider involves the possibility of Hawthorne's Effect influencing participation through device-introduced bias, a variable that can be controlled for with a more randomized, longitudinal study. Based on the results of this and prior studies, training protocols should be considered further by academic institutions in ophthalmology to teach surgeons in training good habits to protect future ophthalmologists from preventable and potentially career-ending injury.

**Conflict of Interest**
None declared.

## References

1 Bonafede L, Kazmierczak L, Siddicky SF, Gunton KB. Ergonomics in strabismus surgery. Curr Opin Ophthalmol 2019;30(05):331–336
2 Sivak-Callcott JA, Mancinelli CA, Nimbarte AD. Cervical occupational hazards in ophthalmic plastic surgery. Curr Opin Ophthalmol 2015;26(05):392–398
3 Alrashed W. Ergonomics and work-related musculoskeletal disorders in ophthalmic practice. Imam Journal of Applied Sciences. 2016;1(02):48–63
4 Carbonaro N, Mascherini G, Bartolini I, et al. A wearable sensor-based platform for surgeon posture monitoring: a tool to prevent musculoskeletal disorders. Int J Environ Res Public Health 2021; 18(07):3734
5 Catanzarite T, Tan-Kim J, Whitcomb EL, Menefee S. Ergonomics in surgery: a review. Female Pelvic Med Reconstr Surg 2018;24(01): 1–12
6 Kitzmann AS, Fethke NB, Baratz KH, Zimmerman MB, Hackbarth DJ, Gehrs KM. A survey study of musculoskeletal disorders among eye care physicians compared with family medicine physicians. Ophthalmology 2012;119(02):213–220
7 Hyer JN, Lee RM, Chowdhury HR, Smith HB, Dhital A, Khandwala M. National survey of back & neck pain amongst consultant ophthalmologists in the United Kingdom. Int Ophthalmol 2015; 35(06):769–775
8 Lakhiani C, Fisher SM, Janhofer DE, Song DH. Ergonomics in microsurgery. J Surg Oncol 2018;118(05):840–844
9 Crawford JO. The Nordic Musculoskeletal Questionnaire. Occup Med (Chic Ill) 2007;57(04):300–301
10 Sivak-Callcott JA, Diaz SR, Ducatman AM, Rosen CL, Nimbarte AD, Sedgeman JA. A survey study of occupational pain and injury in ophthalmic plastic surgeons. Ophthal Plast Reconstr Surg 2011; 27(01):28–32