Surgical Loupe Customization to Prevent Chronic Back and Neck Pain During Ocular Surgeries

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Introduction

Musculoskeletal disorders (MSDs) are the second leading cause of disability globally and are the third leading reason for disability and early retirement in the US. The cost of treating musculoskeletal symptoms (MSS) in the US is >$125 billion per year. Work-related MSDs are estimated to cost between $15-20 billion in workers compensation each year.

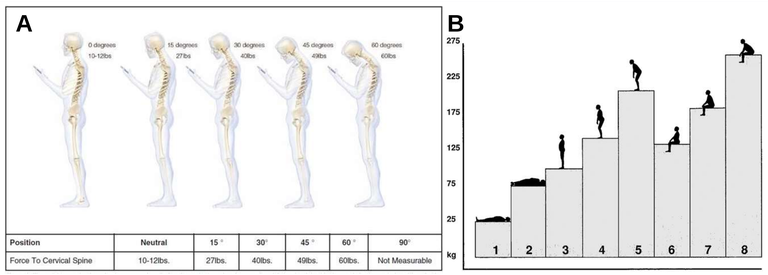
The main risk factors for MSDs in the operating room are prolonged poor static postures which lead to increased incidence of chronic neck and back pain. Among ophthalmologists:

- 32.6% to 69% report chronic neck pain
- 29.8% to 79.6% report chronic back pain.

In order to alleviate symptoms of MSDs, we aimed to modify our surgical loupes to obtain proper ergonomic posture by optimizing:

- Weight of Surgical Loupes
- Declination Angle
- Novel Headstrap
- Reduce force on nasal bridge and superior medial aspect of ears

Force on Cervical and Lumbar Spine



Position	Neutral	15°	30°	45°	60°	90°
Force To Cervical Spine	10-12lbs.	27lbs.	40lbs.	49lbs.	60lbs.	Not Measurable

Figure 1. Force on Cervical and Lumbar Spine for Differing Postures. A) Force on the cervical spine at varying degrees of Neck flexion. **B)** Force on the lumbar spine with different posture.

In order to reduce the incidence of chronic MSS, we must maximize utilization of postures in the OR that provide the least amount of force on cervical and lumbar spines. Figure 1A demonstrates the increased force on the cervical spine with increased neck flexion. To reduce chronic neck pain, the angle of neck flexion should be <20°**.** Furthermore, Figure 1B demonstrates that sitting with incorrect posture during surgery is worse than standing with proper posture, therefore great care should be taken to sit or stand properly during surgery.

Galilean vs Keplerian Telescopes

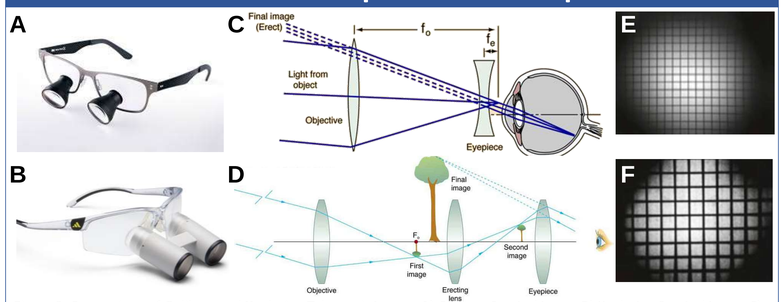


Figure 2. Comparison of Galilean and Keplerian Telescopic Loupes A) Galilean Surgical Loupe **B**) Keplerian Surgical Loupe **C**) Galilean Telescope Lens System **D**) Keplerian Telescopic Lense System **E**) Field of view for Galilean Telescopes **F**) Field of view for Keplerian Telescopes

Galilean surgical loupes are light weight, provide a wide field of view, and magnify 2.0-4.0x the image size.

Prismatic Effect

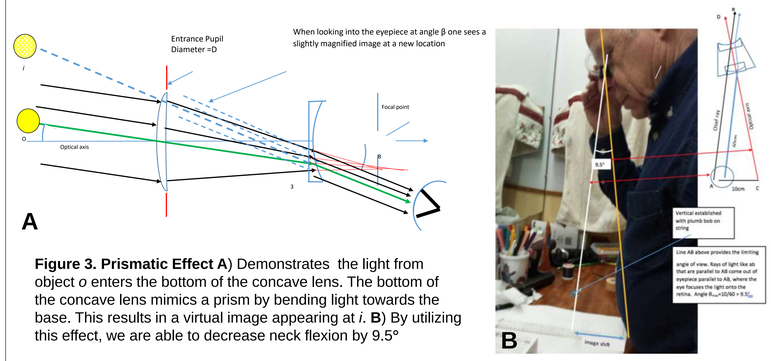


Figure 3. Prismatic Effect A) Demonstrates the light from object *o* enters the bottom of the concave lens. The bottom of the concave lens mimics a prism by bending light towards the base. This results in a virtual image appearing at *i*. **B**) By utilizing this effect, we are able to decrease neck flexion by 9.5°

Angle of Declination

The angle of declination is the angle between the reference line and the optical axis of loupe oculars

- Available range for angle of declination is 25° to 52°
- >45° is uncomfortable
  - Lower Lid Compression
  - Chromatic Aberrations
- Optimal range is **40-42°**

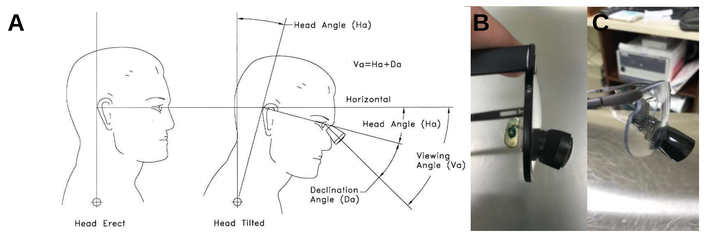


Figure 4. Angle of Declination. A) Demonstration of Angle of Declinations. **B**) Conventional Loupes **C**) Modified Loupes

Suh-Hermsen Strap

- Redistributes Weight off of Nasal Bridge to Top of Head
- Lift loupes from Ears
- Static Strap
- Easily Cleaned

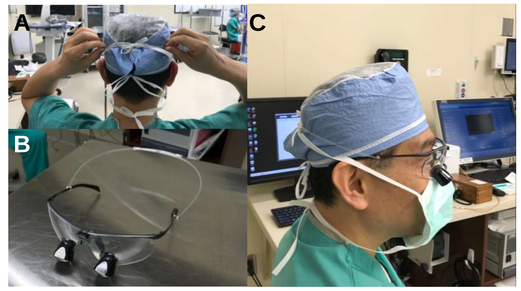


Figure 5. Suh-Hermsen Strap. A) Easily synched strap **B**) Modified Surgical Loupes **C**) Strap allows static positioning of the loupes, offloading weight from ears

Results

- Our modified surgical loupes have an angle of declination of 42° to maximize the prismatic effect and reduce neck flexion
- Lightweight frames and the Suh-Hermsen static strap reduce the force on the nasal bridge by a factor of 2.4x
- Reduces neck flexion from 30°- 45° to <20°

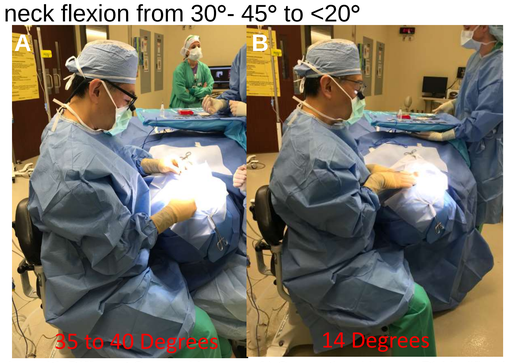


Figure 6. Neck flexion with Different Surgical Loupes. A) Conventional Loupes **B**) Modified Loupes

Conclusions

- Photograph yourself during surgery, and review your posture
- Fit loupes with corrected declination angle (authors support 42 degrees)
- Loupes working distance should be remeasured periodically due to change in our body
- Use a Suh-Hermsen adjustable strap that off loads the weight off the nose and ear.
- Loupes are available from Q OPTICS.

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