

# North Carolina Society of Gastroenterology 2024 Annual Meeting



## ERGONOMIC ENDOSCOPY: Why it Matters?

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American Society for  
Gastrointestinal Endoscopy

# Disclosures:

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# OUTLINE

**The scope of the problem.** Understand prevalence of endoscopy related injury in training and in practice

**The problem of the (endo) scope .**

- Recognize the biomechanical risk factors for repetitive strain injury during endoscopy.
- Hierarchy of controls: Industry solutions

Apply **ergonomics knowledge** to the endoscopy suite

# THE SCOPE OF THE PROBLEM

- Demand for GI endoscopy
- Reduced age for colorectal cancer screening to 45 years
- Increase in the adenoma detection rate
- Increasing utilization of advanced GI procedures
- Users are changing
  - 51% of active GIs are > 55 years
  - Increasing # women in GI

# MUSCULOSKELETAL INJURIES ARE COMMON IN ENDOSCOPISTS

STUDY	Sample size	ERI %
Buschbacher (1994)	265	57%
O'Sullivan (2002) - ERCP	114	67%
Liberman (2005)	582	<b>39%</b>
Byun (2008)	55	<b>89%</b>
Battevi (2009)	179	40%
Hansel (2009)	72	74%
Geraghty (2011)	58	57%
Kuwabara (2011)	190	43%
Riditid (2015)	684	53%
Austin (2019)-Fellow	165	20%
Villa (2019)-Fellow	156	47%
Campbell (2020)-ERCP	203	91%
Morais (2020)	171	75%
Han (2020)Third space endoscopists	45	69%
Al-Rifale (2021)	319	73%
Pawa (2021)	<b>1698</b>	<b>75%</b>
Matsuzaki (2022)	110	79%
Sturm (2022)	151	77%
Pawa (2022)-Fellow	168	55%
Wenley (2022)-Pediatric GI	146	35%
Bessone (2022)	204	89%

- **Endoscopy contributes to INJURY**
- **Risk Factors Independently Associated With Injury**

## **Hansel 2009**

Case – control survey study at **Mayo** of GI physicians compared to non –procedural IM specialties found that rate of musculoskeletal injury was higher in GI group (74% vs 35%,  $p < 0.001$ )

## **Ridtitid 2015 – ASGE**

**684** practicing endoscopists 53% (n=362) experienced ERI

**Risk Factors:** >20 cases/week ( $p < .001$ ), >16 hours procedures/week ( $p < .001$ ), years performing endoscopy ( $p = .004$ ). **55 %** with ERI required interventions

**Hansel JCG 2009**

**Ridtitid GIE 2015**

## **Edelman 2017 – AGA (Abstract only)**

**826** practicing endoscopists

Women = men overall injury

Women > men wrist, elbow, shoulder, upper back, right thumb

Risk factors ( $p < .05$ ) Procedure volume, age, **prior injury**

Training in ergonomics was rare (4.5%)

## **Pawa 2021 – ACG**

**1698** practicing endoscopists 75.2% ( $n=1277$ ) experienced ERI, 90.3% reported more than one injury, 20% took time off for injury. 12% required surgery

Risk Factors: years performing endoscopy ( $p=0.02$ ) and hours per week performing endoscopy ( $p=0.01$ )

**61.5%** reported no training in ergonomics

**Edelman Gastro 153 (5): S217 2017**

**Pawa AJG 2021**

# Endoscopy-Related Musculoskeletal Injuries Are Not Created Equal A National Gender-Based Survey

## Area of ERI



Wrist, Hand,  
Finger/  
Thumb Pain

Upper  
Back Pain

Elbow  
Lower  
Back Pain



## Reported ERI By Gender

♀ 74.5%      ♂ 78.6%

1698  
RESPONDENTS

♀ 583  
♂ 1115

## Pregnancy Related ERI



79 %

## Reported Mechanism of ERI



Non –adjustable  
Bed / Monitor  
Torqueing with  
right hand

Lead Apron  
Use of  
Elevator on  
duodenoscope



Pawa et al. *Am J Gastroenterol* 116(350-8) 2021



## American Society for Gastrointestinal Endoscopy guideline on the role of ergonomics for prevention of endoscopy-related injury: methodology and review of evidence

### Systematic review and meta-analysis

- 17 survey studies
- 5227 respondents

**Overall rate of ERI to be 57.7% (95% CI, 48.8-66.1)**

**Most common sites of ERI were hands and fingers, back, and neck.**

- 8 survey studies
- 3355 respondents

ERI in female endoscopists was 62.4% (95% CI, 46.7-75.9) vs. 45.5% (95% CI, 28.1-64.0) in male endoscopists

**Female endoscopists had higher odds of developing ERIs**

(OR, 1.79; 95% CI, 1.35-2.38;  $P < .01$ , I<sup>2</sup> 64%).

**Pawa et al. ASGE Standards of Practice  
Committee. *GIE* 2023**

# WORK RELATED MUSCULOSKELETAL DISORDERS

- Arise from a complex interaction of events that may accumulate over time
- Injury results from accumulated effects of transient external loads that may, in isolation, be insufficient to exceed internal tolerance of tissues
- When this loading accumulates by repeated exposures or long duration exposures, internal tolerances of tissues are eventually exceeded
- Pain and disability

# GI SPECIFIC RISK FACTORS

## ENDOSCOPE

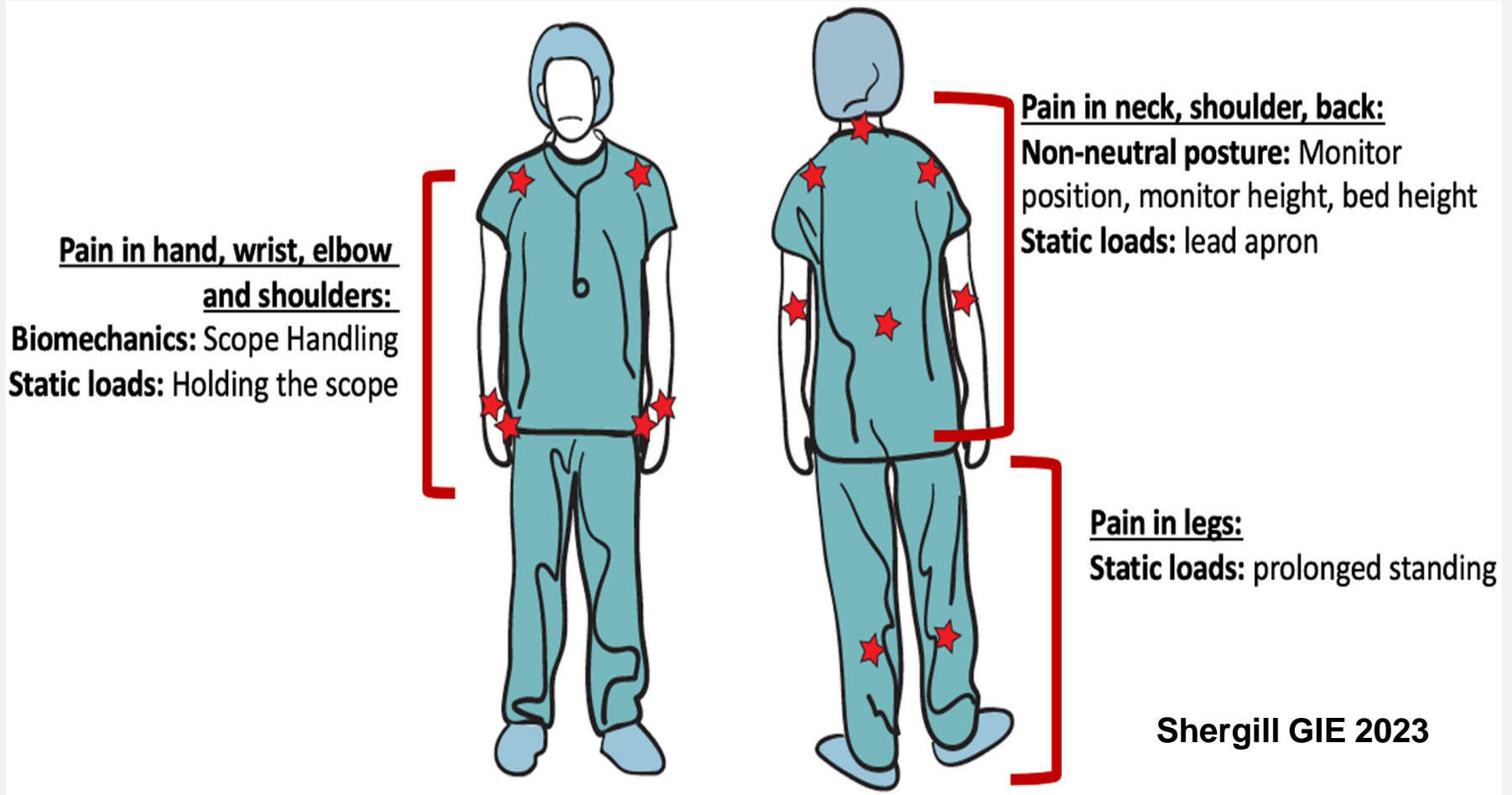
- Repetitive motions
- Awkward non- neutral positions
- Long hours standing
- Sustained static load
- High force

## ERCp

Static load of lead apron



# Endoscopy Related Adverse Events



# DOES HAND SIZE MATTER

## Cohen 2008

- Survey study assessing GI fellow( n=228) perception of effect of hand size on learning and performing endoscopy
- 78.2% (176 ) felt that hand size affects endoscopy learning

## Pawa 2021

- 96.7 % of women reported extra small to medium glove size
- 73% male reported large to extra-large glove size
- Rate of ERI was not significant



## Miller 2022

- measured procedural and anthropometric factors associated with ERI
- small-handed endoscopists (small and medium glove size) had longer colonoscope insertion times (9.4 vs 8.2 minutes, P .04).

# Controller Size Matters: User Proficiency is Affected by Endoscopic Controller Size

 54 endoscopically naïve participants

Smaller glove sizes had better baseline dexterity measures

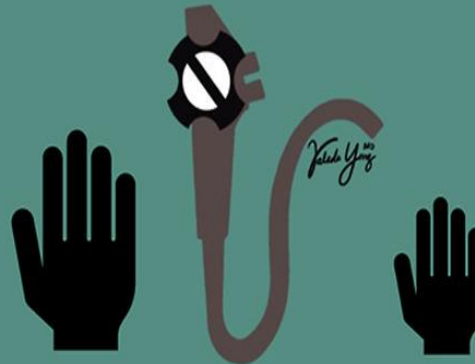


≥7.5

<7.5

p = 0.04

Smaller glove sizes were slower with the larger-handled endoscope and reported more fatigue



124 sec

165 sec

(mean completion time\*)

p = 0.01

No difference in speed or hand fatigue between glove size groups with the smaller-handled bronchoscope



60.9 sec

68.7 sec

(mean completion time\*)

p = 0.61

\*Values are adjusted with a 2-second penalty for each wall contact to standardize accuracy

V Yong, D Kahler, A Schlossberg et al. September 2022.

Scope icons illustrated by Valeda Yong, MD

 @AmJSurgery

**AJS**  
The American  
Journal of  
Surgery\*



# THE PROBLEM OF THE ENDO-SCOPE

Since video endoscopes were introduced (1980s), optics and processing have markedly improved. Minimum parallel advances in endoscope human interface

**One size fits all device for a non one sized workforce.**



# ERGONOMICS

- Scientific study of how work effects people, physically and cognitively
- It is the science of fitting a job to the worker while understanding limitations
- It is based on 2 principles
  - Anthropometry ----- **OPTIMIZE FIT**
  - Biomechanics ----- **MINIMIZE FORCES**

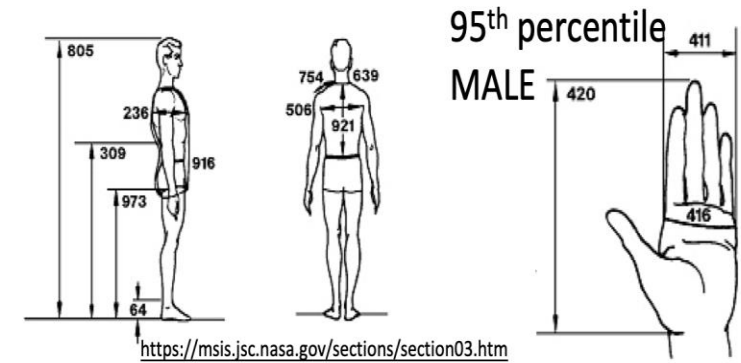
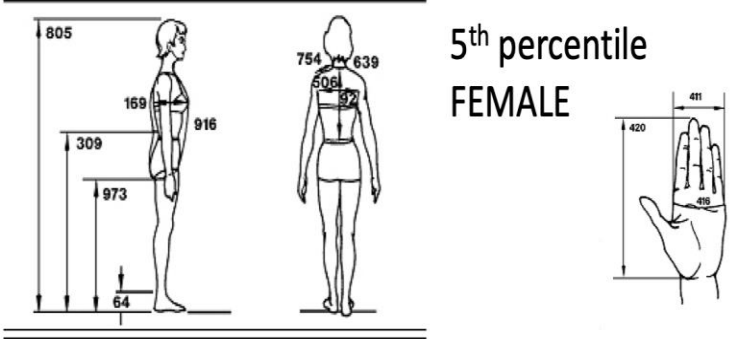
**Kodak's Ergonomics Design for People at Work**



# ANTHROPOMETRY: STUDY OF HUMAN DIMENSIONS

Design tools that can accommodate the **5<sup>th</sup> percentile female** and the **95<sup>th</sup> percentile male** and all in between so that all can use those tools safely.

## Anthropometry

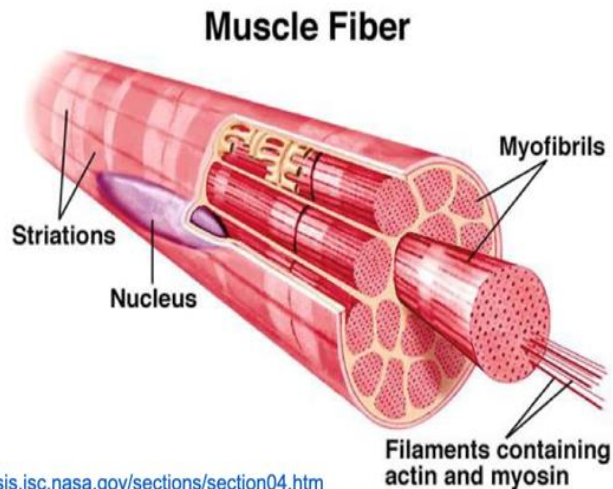


<https://msis.jsc.nasa.gov/sections/section03.htm>

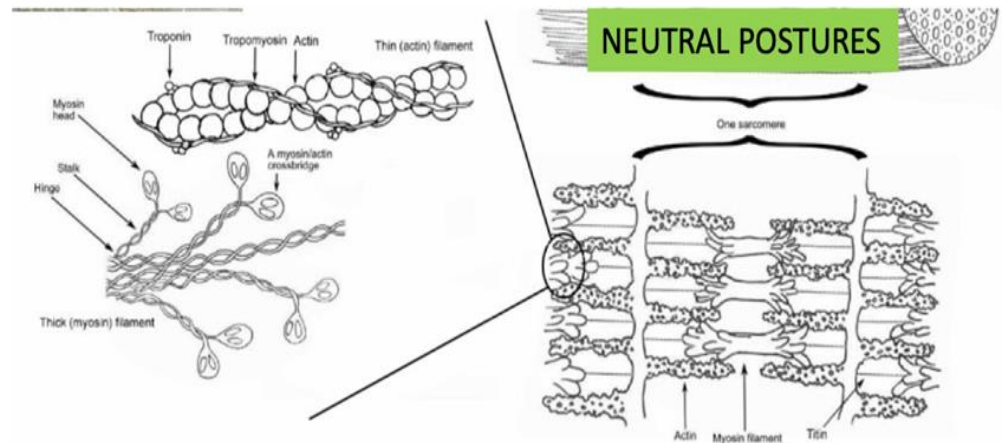


# Biomechanics

- How the body produces force and generates movement.
- Muscle force is influenced by
  - the length-tension relationship of a muscle
  - sheer muscle mass



[msis.jsc.nasa.gov/sections/section04.htm](https://msis.jsc.nasa.gov/sections/section04.htm)  
[www.crossfitoakland.com/.../get\\_strong\\_and.html](http://www.crossfitoakland.com/.../get_strong_and.html)

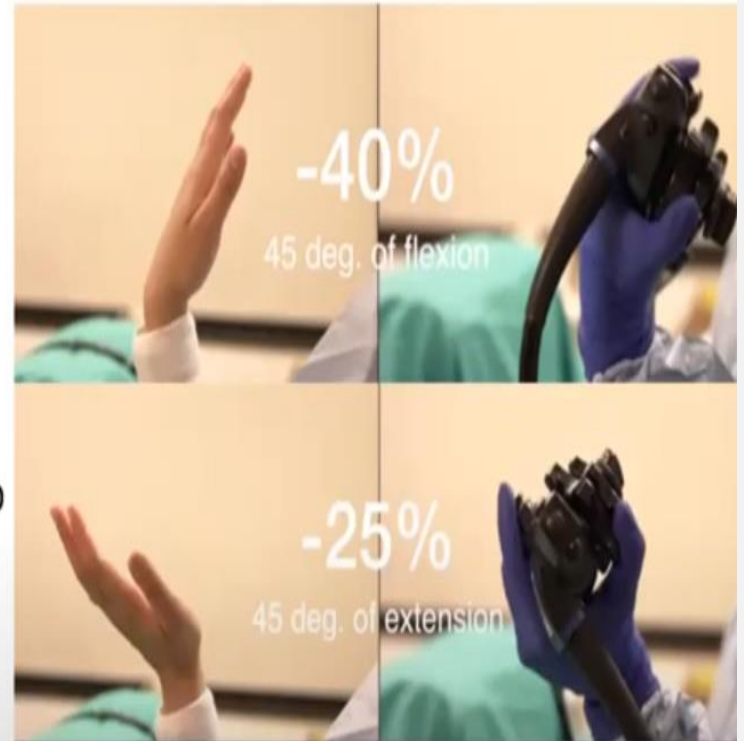


<https://commons.wikimedia.org/w/index.php?curid=73744>

# The Importance of Neutral Posture

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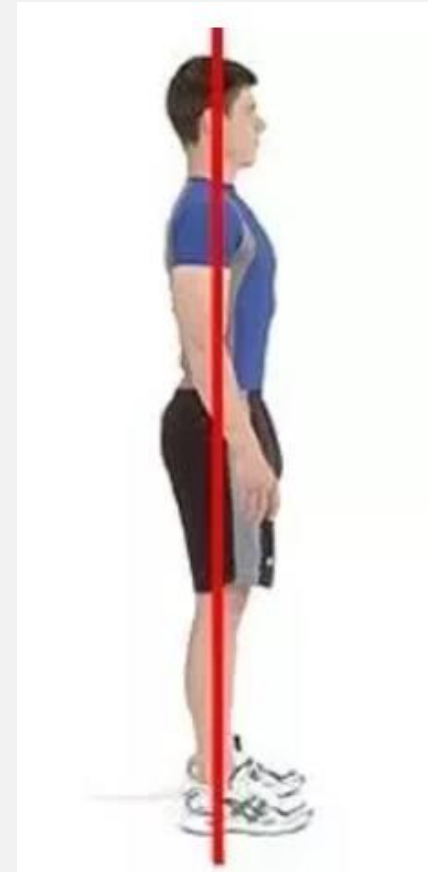
- Defined as “the resting position of each joint” with the “least tension on nerves, tendons, or muscles”
  - The most mechanically advantageous
    - In non-neutral postures, more effort is required for same effect
    - 45-degree flexion of the left wrist decreases grip strength by 40%
    - 45-degree extension of the left wrist decreases grip strength by 25%



**Kodak's Ergonomics Design for People at Work**

# NEUTRAL BODY POSITION

- Comfortable stance
- Standing on both feet
- Equal weight distribution
- Natural curves in back and neck



# GOOD ERGONOMICS IS GOOD ECONOMICS

Evaluates how a job can best be fit to an individual, instead of forcing an individual to fit into a job



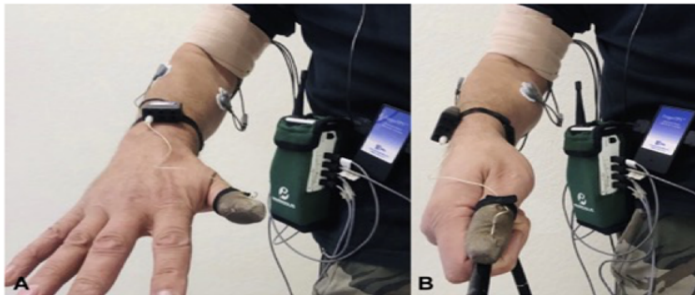
Hendrick 1996 HFES Presidential Address  
"Good Ergonomics is Good Economics"

# Biomechanical risk factors associated with distal upper extremity musculoskeletal disorders in endoscopists performing colonoscopy



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San Francisco, Berkeley, Davis, California; Redmond, Washington, USA



- EMG: Extensor Carpi Radialis (ECR)  
Flexor Digitorum Superficialis (FDS)
- Thumb pinch force

Biomechanical Risk Factor	Risk threshold
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*Peak Forearm muscle load*

- Above Threshold limit value (TLV): **HIGH RISK**
- Above Action limit (AL): **MODERATE RISK**
- Below Action limit: **LOW RISK**

*Peak Thumb pinch force*

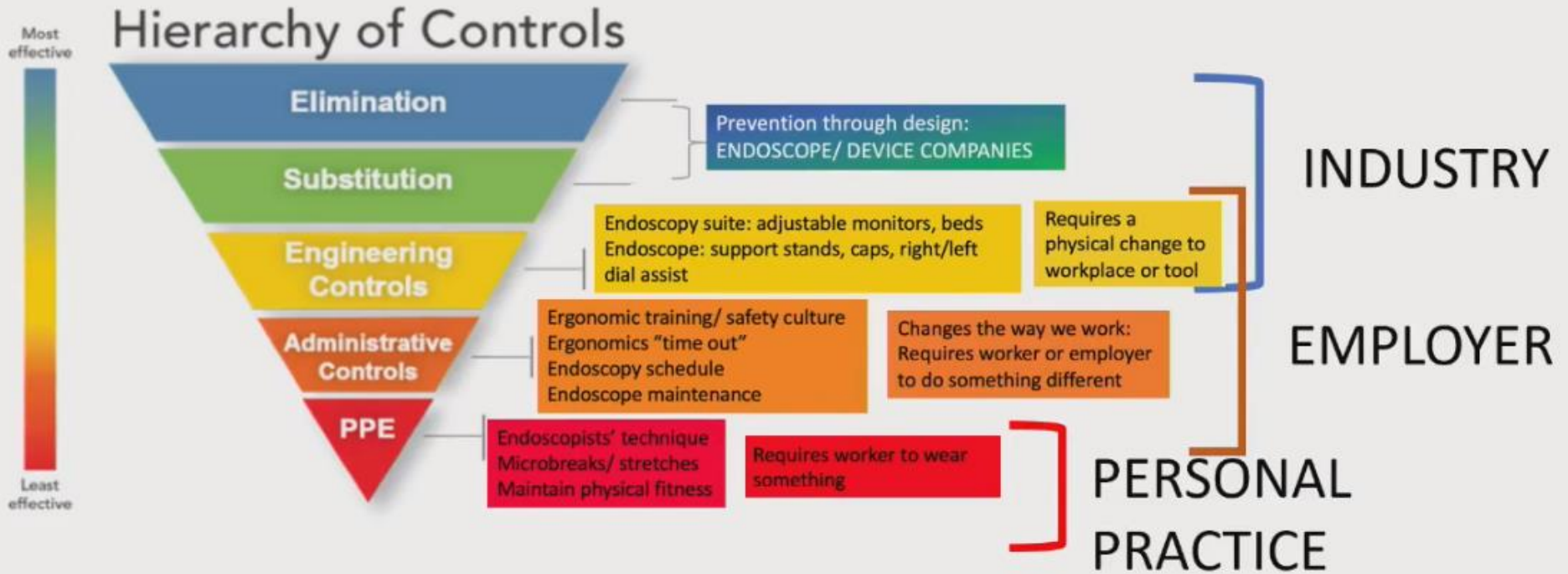
> 11 %time in forceful pinch (>10N)\*\*

\*ACGIH 2020

\*\*Harris Adamson et al 2015

Shergill GIE 2021

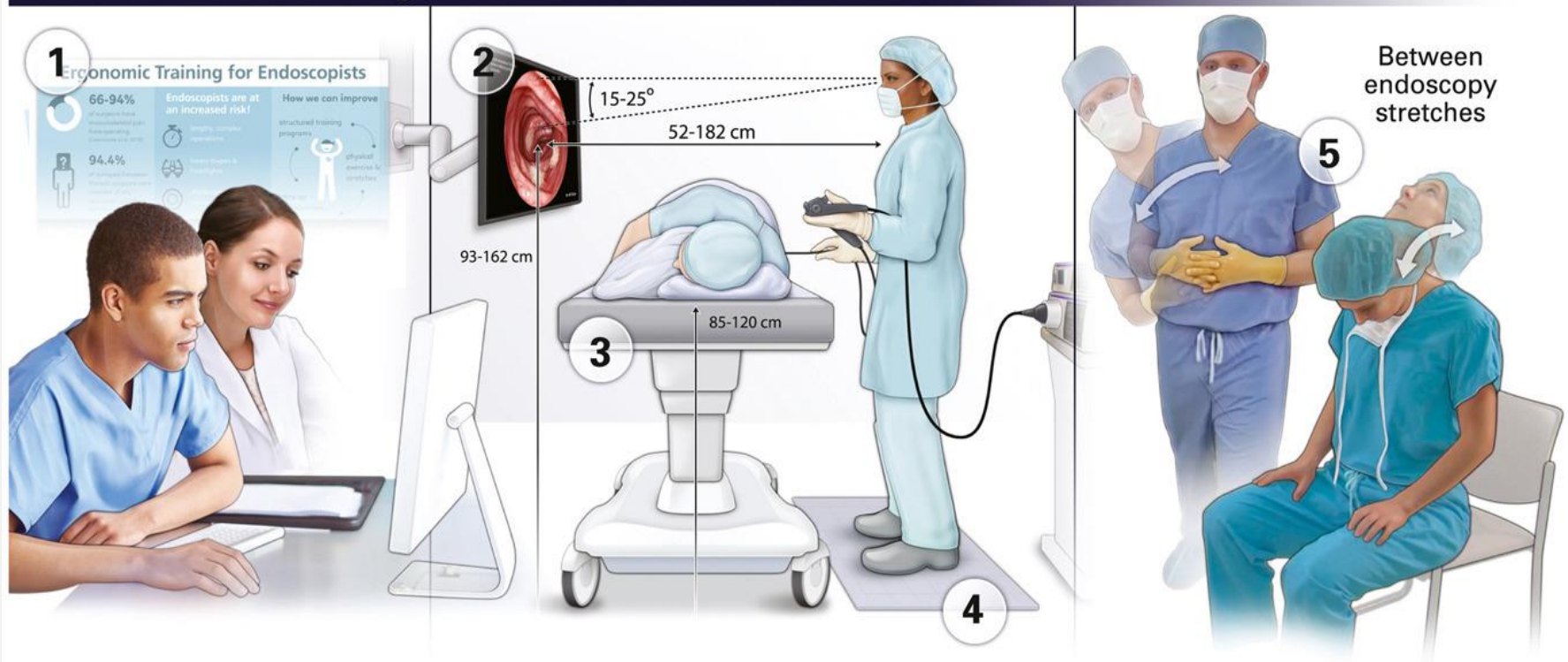
# Solutions to Control Hazards: Endoscopy Related Injury (ERI)



© Shergill

**Figure 1.** The "hierarchy of controls," adapted from the Occupational Safety and Health Administration,<sup>22</sup> illustrates the most and least effective methods for controlling exposures and mitigating the risk of work-related injury. Examples of endoscopy controls are included. *PPE*, Personal protective equipment.

# ASGE Guideline Ergonomics Recommendations



- 1** The ASGE recommends ergonomic education to reduce the risk of ERI. (Strong recommendation, low quality of evidence).
- 2** The ASGE recommends a neutral monitor position during endoscopies to reduce the risk of ERI. (Strong recommendation, low quality of evidence).
- 3** The ASGE recommends the use of neutral bed height to reduce the risk of ERI. (Strong recommendation, very low quality of evidence).
- 4** The ASGE suggests the use of anti-fatigue mats to reduce the risk of ERI. (Conditional recommendation, very low quality of evidence).
- 5** The ASGE suggests that GI endoscopists take micro breaks and scheduled macro breaks to reduce the risk of ERI. (Conditional recommendation, very low quality of evidence).

Pawa et al. ASGE Standards of Practice Committee. *GIE* 2023



# Engineering Control

- Optimal technique: holding the scope
- Right and left dial adaptors making right and left dials more accessible to smaller hands



R/L Dial Adapter



# ERGONOMIC EDUCATION

## Continued reinforcement of behavior modification for performance of endoscopy in Neutral Posture to prevent ERI

- Physical Therapist/Ergonomics Coach
- education sessions, teaching conferences
- online courses
- Short written guides or posters hanging in the endoscopy unit

# MICRO BREAKS

Short biologically meaningful breaks lasting 30 seconds to 2 minutes.

Targeted stretching microbreaks (TSMBs) are 1.5 min stretching breaks at 20 – 40 minute intervals targeting neck, shoulders, back, wrists, hands, knees and ankles

Macrobreaks 15 – 45 minute breaks built into the endoscopy schedule

## Micro Breaks



Hallbeck. The impact of intraoperative microbreaks with exercises on surgeons: A multi-center cohort study. *App Ergo* 2017  
<https://doi.org/10.1016/j.apergo.2016.12.006>  
Supplementary material, unmodified, from Parki et al *Ann Surg* 2017.

# MICROBREAKS

## **Pawa AJG 2021**

**Lower** likelihood of ERI in those who took breaks ( $p=0.002$ )s and micro breaks ( $p=0.016$ )

## **Park Ann Surg 2017**

TSMBs improved physical post procedure pain scores in all evaluated anatomic regions: neck ,right and left shoulder, right and left hand and lower back

Surgeons perceived improvements in physical performance (57%) and mental focus (38%)

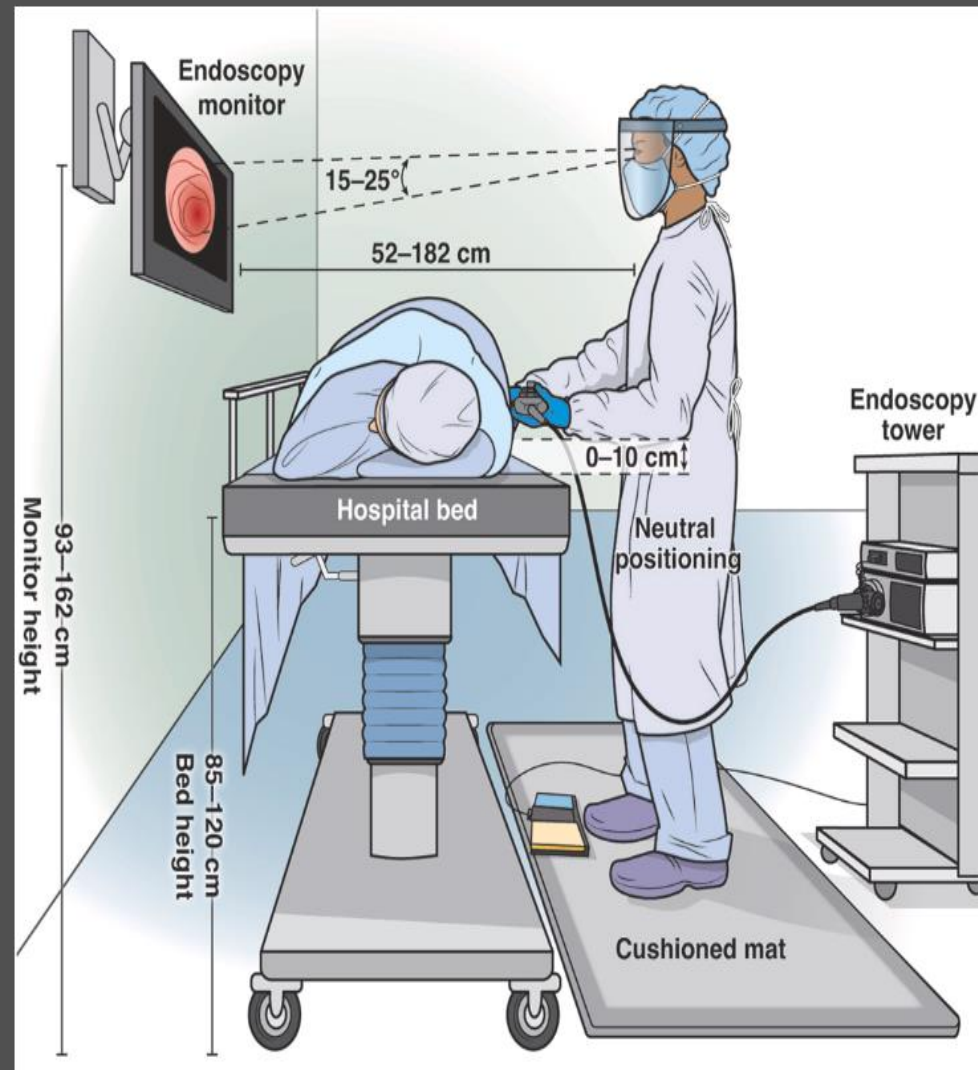
Most surgeons (87%) planned to incorporate TSMBs into their practice.

Operative duration did not differ (  $p>.05$ )

# ERGONOMIC CHECKLIST

## Pre-endoscopy ergonomic checklist

- **Monitor:** directly in front, 15–25° below eye height
- **Bed:** positioned between elbow height and 10 cm below elbow height
- **Endoscopy tower:** endoscope insertion in line with orifice to be intubated (i.e., patient's anorectum or mouth)
- **Foot pedal:** in front of body
- **Cords and wires:** contained on the floor
- **Cushioned floor mat:** in place
- **Led apron (if applicable):** 2-piece
- **Endoscopist position:** neutral posture (back, upper and lower extremities in neutral position and square to the monitor), feet hip-width apart
- **Endoscope positioning:** horizontal positioning of endoscope control head, shaft in 'C position', finger grip 15–30 cm from patient's anorectum
- **Communication:** encourage team members to raise any ergonomic-related concerns



Khan CGH 2023

# SUMMARY

- ERI can be debilitating
- Modifiable and non-modifiable factors can contribute to these overuse injuries
- Most effective measures to prevent ERI are industry and organization –led
- Prioritizing ergonomics and incorporating the new ASGE recommendations may help prevent ERI and disability

# CME/MOC Question:

(multiple choice – list 4 answers to choose from)

Q) Optimal bed height while performing endoscopy is :

- A) At elbow height to 10 cm below elbow height
- B) At elbow height only
- C) At elbow height to 10 cm above elbow height
- D) 10 cm above elbow height

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## CME/MOC Answer

- **A) At elbow height to 10 cm below elbow height**
- If too low – trunk flexed straining para spinal muscles
- If too high – abduction of arms straining deltoid and trapezius muscles.

Joint Providership



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THANK YOU  
FOR YOUR  
ATTENTION

