Ergonomics of GI Endoscopy

KATHERINE S. GARMAN, MD, MHS
DUKE UNIVERSITY
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Disclosures

Katherine S. Garman serves on the Scientific Advisory Board for OBX Associates – Solarium
Learning Objectives

What you wished you learned in fellowship about ergonomics and endoscopy...

Goal: Long satisfying career spent serving patients well while preserving physician health and well-being

Challenge: Endoscopy subjects us to strain, overuse and related micro-trauma and injury
Learning Objectives

What you wished you learned in fellowship about ergonomics and endoscopy

Review the significant risk of musculoskeletal injury faced by gastroenterologists

Learn about optimal room design

Review challenges regarding scope design

Understand the personal risk factors associated with musculoskeletal injury and strategies for mitigating that risk
What is Ergonomics?

“Ergonomics is a multidisciplinary activity striving to assemble information on people’s capacities and capabilities and to use that information in designing jobs, products, workplaces, and equipment.”

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

Reduces fatigue by designing tasks within workers’ capacities.

Ref: Kodak’s Ergonomics Design for People at Work. 2004. Eastman Kodak Company
Why Worry About Ergonomic Issues?

Scope of the Problem:

Gastroenterologists report high rates of musculoskeletal injury related to endoscopy (37-86%)

Highest rates of injury to neck, left thumb and lower back

Women are at higher risk for wrist and shoulder injuries
### Historical Prevalence?

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>% Men</th>
<th>Prevalence of Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buschbacher (ASGE)</td>
<td>1994</td>
<td>95% Men</td>
<td>57%</td>
</tr>
<tr>
<td>Keate (ASGE) (abstract)</td>
<td>2006</td>
<td>Not reported</td>
<td>78%</td>
</tr>
<tr>
<td>Hansel (Mayo)</td>
<td>2007</td>
<td>83% Men</td>
<td>74%</td>
</tr>
<tr>
<td>Lee (Australian) (abstract)</td>
<td>2007</td>
<td>84% Men</td>
<td>37%</td>
</tr>
<tr>
<td>Ridtitid (ASGE)</td>
<td>2015</td>
<td>84% Men</td>
<td>53%</td>
</tr>
</tbody>
</table>

Ref: Technical Review. Shergill et al. ASGE 2009
Education

At Duke, we worked with the AGA to design and conduct the 2016 AGA Ergonomics Survey.

Only 4.5% of respondents reported receiving any training on ergonomics during fellowship.

Best methods for teaching endoscopy and principles of ergonomics remain unknown.
2016 AGA Survey – Types of Injury

Injury in Women – 85.8%

- Eye Strain – 22.2%
- Neck – 37.3%
- Upper Back – 16.1%
- Right Shoulder – 18.5%
- Left Shoulder – 17.1%
- Right Elbow – 8.3%
- Left Elbow – 6.0%
- Lower Back – 34.0%
- Right Wrist – 30.6%
- Left Wrist – 18.6%
- Right Finger – 15.2%
- Left Finger – 13.0%
- Right Thumb – 26.2%
- Left Thumb – 32.7%
- Feet – 21.1%

Injury in Men – 85.8%

- Eye Strain – 21.5%
- Neck – 35.5%
- Upper Back – 8.7%
- Right Shoulder – 12.3%
- Left Shoulder – 11.2%
- Right Elbow – 13.7%
- Left Elbow – 8.7%
- Lower Back – 35.0%
- Right Wrist – 17.5%
- Left Wrist – 15.1%
- Right Finger – 12.0%
- Left Finger – 12.5%
- Right Thumb – 18.7%
- Left Thumb – 34.9%
- Feet – 15.8%
AGA Survey – Predictors of Injury

_Injury since starting endoscopy was associated with:_

- **Any prior injury** (p-value 0.0012)
  
  OR 2.5 (95% CI 1.43 – 4.33)

- **Age (older)** (p-value <0.0001)
  
  OR 1.06 (95% CI 1.03 – 1.08)

- **Number of half days scoping** (p-value 0.0028)
  
  OR 1.5 (95% CI 1.15 – 1.96)

- **Asked to increase procedure volume** (p-value 0.0015)
  
  OR 2.45 (95% CI 1.41 – 4.28)
Be Aware of Risk of Prior Injury

Previous musculoskeletal injury prior to starting a career in endoscopy, is associated with increased risk for pain/injury later.

Example: Fellow with prior hand fracture, wrist or shoulder injury

Consider early consultation with a physical therapist.
Applying Ergonomic Principles to GI Endoscopy

Design of tools (endoscope design)
- Minimize load
- Neutral postures
  - Work in position of max strength
- Appropriate for the 5th percentile female – 95th percentile male

Design of endoscopy suite
- Minimize static loads
- Neutral postures
- Appropriate for the 5th percentile female – 95th percentile male
- Rearranging/redesigning workstations
What Are Ergonomic Improvements?

Changes made to improve the “fit” between a job, its required equipment, and the capabilities of the employees performing it.
Minimizing Force During Scope Insertion

Aim to minimize insertion forces – avoid over-reliance on torque such as “tip deflection, pulling back and suction”

Hold the scope in the left hand in a neutral position (lateral)

Consider resting left hand on patient’s hip

Maximum grip strength decreased with non-neutral wrist postures and glove use

<table>
<thead>
<tr>
<th>Condition</th>
<th>% Max Grip Strength (bare-handed, 5-cm span, neutral wrist angle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 degrees wrist flexion</td>
<td>60</td>
</tr>
<tr>
<td>65 degrees wrist flexion</td>
<td>45</td>
</tr>
<tr>
<td>45 degrees wrist extension</td>
<td>75</td>
</tr>
<tr>
<td>25 degrees of radial deviation</td>
<td>80</td>
</tr>
<tr>
<td>40 degrees of ulnar deviation</td>
<td>75</td>
</tr>
<tr>
<td>Grip span of 2.5cm</td>
<td>40</td>
</tr>
<tr>
<td>Grip span of 11cm</td>
<td>45</td>
</tr>
<tr>
<td>Wearing rubber household gloves</td>
<td>81</td>
</tr>
</tbody>
</table>

Neutral postures maximize force production

Ref: Kodak’s Ergonomics Design for People at Work. 2004. Eastman Kodak Company
Gender, Scope Design and Musculoskeletal Injury

Some endoscopes were designed for a 95\textsuperscript{th} percentile male hand span for proper use – ideally scopes will be eventually be designed to accommodate even a 5\textsuperscript{th} percentile hand size.

Women experience greater risk of right thumb, right wrist, right shoulder, upper back pain

Consider early PT if you are experiencing these symptoms while we await better scope design
2016 AGA Survey

**Microbreaks** – taken by 15% women and 13% of men

**Ergonomic time-out** – used by 9% women and 7% men

Ridtitid et al GIE 2015:

- 34% reported no breaks
- 45% reported only occasional breaks
Importance of Rest: Example - EGD

Assuming the force required to handle the endoscope is light or very light:

After maintaining static grasp of the endoscope for 3 min (such as during EGD) → Requires 3 minutes recovery time

7.5 min procedure → Recovery time = 45 minutes

No data to guide rest requirements for estimated force levels and average duration of colonoscopy

Ref: Battevvi et al. Med Lav. 2009 May-Jun;100(3):171-7
What is a Micro Break?

Opportunity to relax from static positions, increase blood flow, stretch

Data are lacking on optimal technique

Consider: shaking out hands and wrists, rolling shoulders, stretching hands and fingers

See ACG video on Ergonomics of Endoscopy http://universe.gi.org/vow/14879.htm

“Athletic stance”
AGA Survey – Frequent vigorous exercise was inversely associated with musculoskeletal injury

<table>
<thead>
<tr>
<th></th>
<th>Vigorous exercise 0-1x per week</th>
<th>Vigorous exercise 2-3x per week</th>
<th>Vigorous exercise 4-6x per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>No injury since starting endoscopy</td>
<td>15.9%</td>
<td>34.1%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Injury reported since starting endoscopy</td>
<td>26.3%</td>
<td>50.8%</td>
<td>22.9%</td>
</tr>
</tbody>
</table>

*p-value 0.0007*
AGA Survey – Room Design

How common is proper positioning of table and monitor?

89% used adjustable tables all or most of the time (8% never used adjustable tables)

8% set the table above elbow height (shoulder, upper back strain)

67% used an adjustable monitor or screen all or more of the time (6% never had an adjustable monitor or screen)

41% reported having the monitor above eye level
Posture: Examination Table

Optimal ergonomic room design associated with lack of injury

Table should be at or below elbow height
(0-10 cm below the elbow)

Adjustable bed / table – height should go from 85 to 120 cm

Monitor height should be just below eye level

Viewing angle of 15 to 25 degrees below the horizon

Viewing distance of 52 to 182 cm

Adjustable from 93 to 162 cm

Algorithm for Ergonomics Time-Out

Check at the start of each procedure (1 of 2):

Adjust monitor for endoscopist’s height with goal of center of monitor at eye level or below and directly positioned in front of the endoscopist.

Adjust bed height so that table is between elbow height and 10cm below elbow height.

Use anti-fatigue floor mats for endoscopist and assisting staff.
Algorithm for Ergonomics Time-Out

Check at the start of each procedure (2 of 2):

When fluoroscopy is used, wear two-piece lead aprons.
During the procedure, strive for neutral stance and avoid contortions.
Refine endoscopic technique to minimize force during scope insertion.
Always use two or more staff to move heavy patients.
Consider micro-breaks between procedures to relieve stress and relax from static and/or strained positions.
Scope Design

Better Scope Design is Encouraged

While beyond the individual endoscopist’s control, do consider working with engineers, industry, and professional organizations to encourage improvements in scope design for protection of endoscopists
Debate: Individual vs Scope Re-Design

According to principles of ergonomics, burden should not be on the individual but rather on environmental and equipment changes.

However, PT may be an important step, particularly for physicians who are suffering from injury now.
Duke Ergonomics PT Pilot Study

*Individualized Assessment and Wellness Programs to correct poor postural habits, reduce pain, and improve strength*

Data Collection: Prior injury, baseline posture assessment, observation during procedures

Suite set-up evaluated

Dynamic posture observed during procedures (baseline and tired)

Each location of subjective pain evaluated for exacerbating movement patterns or loading

*Unpublished data courtesy of Melissa Teitelman Grotegut, Stacy Markwell and Iris Vance*
**Resting posture:** In each set of pictures above, the first picture is your self-selected baseline posture and the second is your “tired” posture. You demonstrate forward head posture with rounded shoulders (note how the palms of your hands point posteriorly). When you are not “tired”, you demonstrate symmetry left to right. This is very beneficial in creating a stable base to support your extremities and protect your spine during procedures. The “tired” posture however does not provide this protective benefit. While the “tired” posture assessment is used to highlight and confirm deviations in baseline posture, you were observed to move into this posture intermittently during procedures and between procedures.
Duke Ergonomics PT Pilot Study

All participants felt their wellness plan was helpful.

8/8 - Posture education and procedure suite recommendations helpful

87.5% Pictures depicting posture and movement analysis were helpful

50% of the participants found the pain education plan helpful

25% found the personalized wellness exercise instruction helpful

3/8 of the participants asked the physical therapist to return to repeat observation and intervention
Take Home Points (Empowerment)

Educate yourself, your colleagues and your fellows on best ergonomic practices

Be aware of risk related to prior injuries

Take an ergonomic time-out

Insist on an adjustable screen and set center at eye level or below

Use an adjustable table

Schedule and take microbreaks
Aim for vigorous exercise 4-6x / week
KNOWLEDGE CHECK QUESTIONS
Thank you!