An estimation of the endoscopist's musculoskeletal injury risk for right and left lateral decubitus positions during colonoscopy: a field-based ergonomic study (S197)

Maxim Landry
Memorial University of Newfoundland Faculty of Medicine
https://orcid.org/0000-0003-4113-2192

Sarah Mackey
Memorial University of Newfoundland Faculty of Medicine

Intekhab Hossain
Memorial University of Newfoundland Faculty of Medicine

Nicholas Fairbridge
Memorial University of Newfoundland Faculty of Medicine

Alison Greene
Dalhousie University Faculty of Medicine

Mark Borgaonkar
Memorial University of Newfoundland Faculty of Medicine

Kimberley Cullen
Memorial University of Newfoundland

David Pace
Memorial University of Newfoundland Faculty of Medicine

Diana De Carvalho (✉ Diana.DeCarvalho@med.mun.ca)
Memorial University of Newfoundland
https://orcid.org/0000-0001-9474-4286

Research Article

Keywords: Ergonomics, Colonoscopy, Left Lateral Decubitus, Right Lateral Decubitus, Musculoskeletal Injury

Posted Date: October 20th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1857745/v1

License: ☛ ☉ This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License
Version of Record: A version of this preprint was published at BMC Musculoskeletal Disorders on June 10th, 2023. See the published version at https://doi.org/10.1186/s12891-023-06606-4.
Abstract

Background

Colonoscopy exposes endoscopists to awkward postures and prolonged forces, which increases their risk of musculoskeletal injury. Patient positioning has a significant impact on the ergonomics of colonoscopy. Recent trials have found the right lateral decubitus position is associated with quicker insertion, higher adenoma detection rates, and greater patient comfort compared to the left lateral decubitus position. However, this patient position is perceived as more strenuous by endoscopists.

Methods

Nineteen endoscopists were observed performing colonoscopies during a series of four-hour endoscopy clinics. Durations of each patient position (right lateral decubitus, left lateral decubitus, prone, and supine) were recorded for all observed procedures (n = 64). Endoscopist injury risk was estimated by a trained researcher for the first and last colonoscopies of the shifts (n = 34) using Rapid Upper Limb Assessment (RULA), an observational ergonomic tool that estimates risk of musculoskeletal injury by scoring postures of the upper body and factors such as muscle use, force, and load. The total RULA scores were compared with a Wilcoxon Signed-Rank test for patient position (right and left lateral decubitus) and time (first and last procedures) with significance taken at p < 0.05. Endoscopist preferences were also surveyed.

Results

The right lateral decubitus position was associated with significantly higher RULA scores than the left lateral decubitus position (median 5 vs. 3, p < 0.001). RULA scores were not significantly different between the first and last procedures of the shifts (median 5 vs. 5, p = 0.816). 89% of endoscopists preferred the left lateral decubitus position, primarily due to superior ergonomics and comfort.

Conclusion

RULA scores indicate an increased risk of musculoskeletal injury in both patient positions, with greater risk in the right lateral decubitus position.

Introduction

Gastrointestinal (GI) endoscopy is an essential tool in the screening, diagnosis, and treatment of numerous GI conditions [1–4]. For the physician, it involves repeated pinching and gripping movements, as well as unnatural hand, wrist, elbow, shoulder, and neck positions, increasing musculoskeletal injury (MSI) risk with cumulative exposures [5–7]. According to various reports, 39–89% of endoscopists
develop occupational musculoskeletal pain or injuries during their careers [1]. One particular survey of 684 endoscopists revealed that 53% had experienced a MSI perceived to be related to endoscopy [7]. Some of the most commonly reported repetitive-use injuries amongst endoscopists include: chronic neck strain, carpal tunnel syndrome, De Quervain's Tenosynovitis (also known as "Colonoscopist's Thumb"), and low back pain [8, 9]. Right upper extremity MSIs have been reported to result from torquing the colonoscope, while left upper extremity MSIs have been reported to result from turning control dials, particularly in the case of stiff dials and lengthy procedures [8, 9]. Neck and back pain are primarily the results of fixed, awkward monitor placement, and knee pain has been reported from pivoting to see the monitor [10]. Elevated risk of MSI has been demonstrated in some cohorts of endoscopists, including females, suggested to be due to decreased ability to generate force, and novices, potentially because of their increased procedure times resulting in increased cumulative exposure [11, 12]. In addition, higher procedural volume (> 20 patients/week and > 16 hours/week), is associated with greater MSI risk [13]. MSIs can adversely affect physicians’ abilities to perform these procedures and result in lost-work-time and diminished quality of life [11].

Despite the ergonomic challenges of endoscopy and the implications for MSIs, a literature review of occupational hazards for endoscopists revealed that ergonomics remains a neglected aspect of endoscopy training and practice [14, 15]. In a survey of gastroenterology fellows, 72% responded that they did not feel they had received any formal training on preventing overuse injuries. In that same study, 27% responded “yes” or “maybe” to sustaining MSIs related to endoscopy, while 67% felt it was likely that they would sustain endoscopy-related MSIs over the course of their careers [16]. A recent study showed that a simulation-based ergonomics training curriculum is associated with reduced risk of MSI during colonoscopy [12]. Subsequently, the American Society for Gastrointestinal Endoscopy (ASGE) published a core curriculum for ergonomics in endoscopy which discusses technical factors including appropriate body position and room setup during endoscopy, proper technique for holding and handling the endoscope, and various strategies (e.g., turning patients, torque steering) to minimize musculoskeletal load [17].

Patient position during colonoscopy may also impact MSI risk. Though data is conflicting, the right lateral decubitus (RLD) position has been found to decrease time to reach the cecum by 30% and increase patient comfort compared to the left lateral decubitus (LLD) position [18]. However, this patient position requires more extreme postures on the part of the endoscopist to reach over the patient, potentially increasing MSI risk. Endoscopists have reported anecdotally that the RLD position is perceived to be more strenuous than the LLD position; however, this has yet to be studied formally. Therefore, the purpose of this investigation is to determine whether there is a difference in MSI risk for the endoscopist when performing colonoscopies with patients in the RLD and LLD positions.

Materials And Methods

Participants
Nineteen endoscopists were recruited from the Health Sciences Centre and St. Clare's Mercy Hospital (St. John’s NL). This cohort included 12 males, 7 females, 95% right hand dominant, average experience 12 (sd 11) years, average height 1.73 (sd 0.10) m, average weight 79.3 (sd 10.6) kg, average BMI 26.3 (sd 2.8) kg/m$^2$, median glove size 7.5 (MAD 0.5). All endoscopists had previously completed a colonoscopy skills improvement course where optimal bed, stack, patient, and monitor position were discussed. Appropriate posture, hand position, and scope handling were also discussed, and feedback was given during and after the performance of colonoscopies. Informed consent was obtained from each clinician and their patients. This study was approved by the local Health Ethics Research Board.

**Rapid Upper Limb Assessment (Rula)**

The Rapid Upper Limb Assessment (RULA) tool was utilized to assess the practitioners’ MSI risk with patients in the RLD and LLD positions [19]. This observational tool is a snapshot in time and involves the rater identifying and scoring the “worst” upper body posture adopted by a worker while considering factors such as muscle use, force, and load. The minimum RULA score is 1 and the maximum RULA score is 7. As the score increases, the risk of MSI increases.

For this study, a trained and experienced rater performed all RULA assessments on the endoscopists’ right upper extremities by standing perpendicular to them with an unobstructed view to minimize errors in estimating body position. The tool took approximately three minutes to complete per posture and did not interfere with the colonoscopy procedure.

**Patient Position Exposure**

The duration of each patient position was timed with a stopwatch and recorded by a researcher in the room. The stopwatch was started when the procedure had begun, or the patient had settled in a new position and the examination restarted, and stopped when the patient was repositioned, or the procedure was completed.

**Endoscopist Questionnaire**

At the end of each clinic, clinicians were given a questionnaire assessing their preferred patient position and their perception of the musculoskeletal demands in both positions (RLD and LLD). The first question included a 5-point Likert scale ranging from “strongly disagree” to “strongly agree” with the statement “The patient position at the start of the procedure today is my preferred position for this procedure.” Next, the following questions were asked: [1] Which patient position do you prefer? (Circle one: RLD/LLD), [2] Considering your most preferred patient position, what do you like about performing this procedure with the patient in this position? (Free comment text, no limit) and [3] Considering your least preferred patient position, what do you dislike about performing this procedure with the patient in this position? (Free comment text, no limit).
**Data Collection**

The clinicians were observed performing elective colonoscopies throughout the duration of a series of four-hour shifts. Demographic information for each patient (age, sex, height, weight) and clinician (height, weight, glove size, years of experience) were collected. Each practitioner was instructed to begin the first (n = 30) and last (n = 25) colonoscopy of the shift with the patient in the RLD position, after which they were permitted to position the patient as preferred. A trained observer used the RULA tool to assess the endoscopist’s right upper extremity while the patient was in either the LLD (n = 22) or RLD (n = 33) position. Additionally, the time each patient spent in each position (LLD, RLD, supine and prone) was recorded for each procedure during the shift. At the end of each shift, the endoscopists were given the questionnaire.

**Statistics**

The dependent measures for this investigation were the RULA scores for each patient position (RLD/LLD) during the first and last procedures of the endoscopists’ shifts. SPSS statistical package version 27 (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp) was used for all statistical analyses. The total RULA scores were compared with a Wilcoxon Signed-Rank test for patient position (RLD and LLD) and time (first and last procedures) with significance taken at p < 0.05. Ordinal regression was performed to assess the influence of patient and practitioner characteristics on RULA scores.

**Results**

**Participant Characteristics**

The colonoscopies of 64 different patients were observed (28 male, 36 female, average age 63 (sd 13) years, average height 1.67 (sd 0.09) m, average weight 80.0 (sd 20.1) kg, average BMI 28.7 (sd 5.9) kg/m$^2$). RULA scores were recorded for 34 of these patients. RULA scores were excluded from statistical analysis when there was no corresponding score during the same procedure in the opposite patient position (RLD vs LLD) AND no corresponding score for the same patient position during the other RULA-scored procedure of the shift (first vs last).

**RULA Scores**

The RLD patient position was associated with significantly higher RULA scores than the LLD position (median 5 vs. 3, p < 0.001, z=-4.029). See Fig. 1. RULA scores were not significantly different between the first and last procedures of each shift (median 5 vs. 5, p = 0.816, z=-0.233). The frequency distribution of RULA scores with patients in the RLD and LLD positions during the first and last procedures of the shifts is shown in Fig. 1. The strong protective effect of the LLD position masked any variation that may have
been associated with patient or endoscopist characteristics. RULA scores did however show more variation with patients in the RLD position. Thus, only RLD RULA scores were used in an ordinal regression to examine patient and practitioner characteristics. RLD RULA scores showed no relationship to clinician glove size, sex, age or experience. However, an increase in clinician weight was associated with increased RULA scores, while an increase in clinician height was associated with decreased RULA scores with the patient in the RLD position (Table 1). Patient characteristics (height, weight, BMI, age, sex) did not have any influence on RULA score.

### Table 1
Ordinal regression examining the influence of practitioner characteristics on RULA scores.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Relative Odds</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (m)</td>
<td>-136</td>
<td>56.9</td>
<td>5.68</td>
<td>1</td>
<td>0.017</td>
<td>1.23e-59</td>
<td>4.38e-108</td>
<td>3.46e-11</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>1.25</td>
<td>0.573</td>
<td>4.77</td>
<td>1</td>
<td>0.029</td>
<td>3.49</td>
<td>1.14</td>
<td>10.7</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>-3.93</td>
<td>1.71</td>
<td>5.31</td>
<td>1</td>
<td>0.021</td>
<td>0.020</td>
<td>6.96e-4</td>
<td>0.556</td>
</tr>
<tr>
<td>Glove size</td>
<td>Not significant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td>Not significant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Not significant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handedness</td>
<td>Not significant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm with most discomfort</td>
<td>Not significant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Endoscopist Preferences

The average time patients spent in the RLD position was 7.30 (sd 4.53) minutes per procedure and in the LLD position was 9.18 (sd 7.40) minutes. 47% (n = 9) of endoscopists noted their left arm causing them the most discomfort while performing the procedure, 32% (n = 6) felt it was their right arm, and 21% (n = 4) did not favor one side over the other. 89% (n = 17) chose LLD as their preferred position of the two, while 5% (n = 1) chose RLD. 5% (n = 1) were undecided. All clinicians who preferred the LLD position (n = 17) cited physical challenges associated with leaning over the patient in the RLD position. Back pain (n = 3), upper body pain (n = 2), calf pain (n = 1), increased difficulty torquing the scope (n = 2), and an inability to maintain a neutral wrist posture (n = 1) were also cited as factors contributing to their non-preference of the RLD position. Comments favoring the RLD position mentioned quicker time to reach the splenic flexure (n = 1) and ease of navigating difficult sigmoid colons (n = 1).
Discussion

Analysis of RULA scores suggests that the performance of colonoscopy with patients in both the RLD and LLD positions is associated with an increased MSI risk, though the RLD position was found to pose a greater risk (median 5 vs. 3, p < 0.001, z=-4.029). Furthermore, the LLD position was protective against variation in RULA scores associated with endoscopist characteristics, which was seen with RLD patient positioning. Given that colonoscopy is usually performed with a LLD patient position, which favors endoscopist comfort, many endoscopists will likely be reluctant to move patients into the RLD position. This is despite the potential benefits of RLD positioning, including improved mucosal visualization in the cecum [20] and left colon [21], higher adenoma detection rates in the left colon [22], and possibly quicker insertion times [18].

The performance of colonoscopy with the patient in the RLD position makes the initial rectal exam and colonoscope insertion more awkward for the endoscopist. Visualization is impaired and the endoscopist must reach over the patient’s hips to perform these maneuvers. In addition, the RLD position forces the endoscopist to reach forward given that the anus is further away from the side of endoscopy table. This results in flexion of the endoscopist’s hips, extension of the arms, and extension of the neck to maintain a good view of the monitor, potentially leading to discomfort and injury. Heavier endoscopists are even more hindered by these maneuvers, while taller endoscopists are less so, as shown in Table 1. These observations are consistent with questionnaire responses, where most physicians (89%) reported a preference for the LLD position over the RLD position. This preference was also reflected in the duration that endoscopists had patients in each position, which was longer for the LLD position (mean 9.18 min) than the RLD position (mean 7.30 min).

The RULA scores in this study, with median scores ranging from of 3 to 5, were much lower than those noted in the simulation-based study by Khan et al [12]. This can be explained by the fact that the endoscopists in our study were more experienced and had all received ergonomics training during a hands-on colonoscopy skills improvement course. The creators of RULA recommend further investigation into the activity with possible implementation of changes when a mean RULA score of 3–4 is obtained, which is where the endoscopists scored with the patient in the LLD position. The recommendation associated with a RULA score of 5–6, where the endoscopists scored with the patient in the RLD position, is for further investigation and timely changes [19].

Limitations to this study include its small sample size and non-blinding of the assessor. Also, the number of procedures per shift and intervening procedures, such as gastroscopies and sigmoidoscopies, between colonoscopies could not be standardized due to logistical challenges. This negated the possibility of accurately assessing the accumulation of fatigue during a shift. An in-depth biomechanical analysis of practitioner posture and muscular demand in a laboratory-controlled study of the simulated patient positions would further our understanding of this issue and is underway.

This is the first study to evaluate the ergonomics of RLD patient positioning during colonoscopy. It provides evidence that colonoscopy significantly increases MSI risk, and that patient positioning is a
significant factor influencing the ergonomics of colonoscopy. From an ergonomic standpoint for endoscopists, performing colonoscopies with the patient in the RLD position is much less comfortable than the LLD position and poses a greater MSI risk. It should thus only be used at specific points in the procedure to optimize visualization or to aid in colonoscope insertion. Further, efforts need to be made to improve the ergonomics of the procedure. Even though the endoscopists in this study knew about the importance of ergonomics and had received instruction to improve their technique, their RULA scores were still higher than desirable. Potential solutions include a more ergonomic colonoscope design and/or a fully automated colonoscopy insertion device. Also, the avoidance of deep sedation, which is commonly used in many centers, facilitates position change, which may limit injury to those responsible for moving patients during the procedure [23]. Future work should expand upon the existing practical knowledge for the improvement of the ergonomics of colonoscopy.

Declarations

Ethics Approval and Consent to Participate

This study received ethics approval from The Newfoundland and Labrador Health Research Ethics Authority (#20181053). All participants completed the informed consent process prior to their participation in the study including giving written consent.

Consent for publication

Not applicable.

Acknowledgements

The authors wish to thank the Health Sciences Centre GI unit for accommodating the collection of this data.

Availability of Data and Material

The full dataset will be made available upon request.

Competing Interest

The authors have no conflicts of interest to disclose.

Funding

This project was funded by the Natural Sciences and Engineering Research Council of Canada Discovery Grant #20161771

Author Contribution
All authors contributed to the design of this study. Equipment and software for the study were provided by DDC. ML and SC collected the data. NF conducted the statistical analysis and all authors contributed to the interpretation of results and the writing of this manuscript. All authors have read and agree with the final manuscript.

References


Figures
Figure 1

Frequency distribution of RULA scores. Patients in the right and left lateral decubitus positions (RLD/LLD) during the first and last procedures of endoscopy shifts (First/Last). Wilcoxon Signed-Rank tests were conducted to compare ranked scores between RLD/LLD and between first/last procedures. The LLD patient position demonstrated a protective effect to physician ergonomics as suggested by RULA scores (median 5 vs. 3, p<0.001, z = -4.029).