

Prevalence and impact of musculoskeletal pain in Japanese gastrointestinal endoscopists: A controlled study

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Abstract

AIM: To examine the frequency and prevention of musculoskeletal pain in Japanese gastrointestinal endoscopists and non-endoscopist physicians.

METHODS: Questionnaires were sent to 275 endoscopists and 173 non-endoscopists working in Hiroshima University Hospital and its affiliated hospitals.

RESULTS: The completed questionnaires were returned by 190 (69%) endoscopists and 120 (69%) non-endoscopists. The frequency of pain in the hand and wrist, and especially the left thumb, was significantly higher in endoscopists than in non-endoscopists (17% vs 6%, $P = 0.004$). Using multivariate analysis, the only significant factor associated with this pain was the age of the endoscopist (odds ratio 2.77, 95% confidence interval,

1.23-6.71, $P = 0.018$). Interestingly, endoscopists had made significantly fewer modifications to their endoscopic practices than non-endoscopists (12% vs 33%, $P < 0.0001$) to prevent pain.

CONCLUSION: Pain in the hand and wrist may be endoscopy-related. However, endoscopists made little modifications in practice to prevent such pain. More attention to prevention appears necessary.

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Key words: Endoscopy; Musculoskeletal pain; Pain prevention

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INTRODUCTION

Muscle and joint pain is a common complaint in individuals whose jobs require repetitive isometric maneuvers or awkward body positions^[1]. Such pain has been reported in individuals with various occupations such as bus drivers^[2], unskilled laborers^[3], musicians^[4], physical therapists^[5], and computer keyboard operators^[6]. Recently, ergonomic mechanisms related to the development of work-related musculoskeletal disorders have drawn substantial interest.

Endoscopy in clinical gastroenterology is becoming more important not only in Western countries but also in

Eastern countries including Japan^[7,8], and the number of endoscopic examinations and treatments has increased rapidly. In addition, procedures requiring long performance time such as endoscopic submucosal dissection^[7,9], endoscopic sphincterotomy, and endoscopic papillary balloon dilatation are commonly performed. The work burden of endoscopists has significantly increased.

Evidence suggests that endoscopists frequently report a variety of musculoskeletal problems including neck pain, low back pain, and thumb and hand pain^[10,11]. On the basis of previous reports, it has been suggested that the performance of endoscopy predisposes the operator to the development of musculoskeletal pain. However, there is little published evidence of this, and most of this evidence comes from Western countries; little evidence has come from Eastern countries including Japan. More attention needs to be paid to the impact of musculoskeletal pain and its prevention in Eastern countries. Therefore, we examined the frequency of musculoskeletal pain in Japanese gastrointestinal endoscopists and non-endoscopist physicians. The use of pain prevention strategies and physician requests to improve endoscopic design were also examined.

MATERIALS AND METHODS

General overview

Questionnaires were sent to endoscopists and non-endoscopist physicians working in Hiroshima University Hospital and its affiliated hospitals. The questionnaires were sent with an introductory letter explaining the study. The survey was conducted between March and May, 2010.

Subjects

Subjects consisted of endoscopists and non-endoscopist physicians in Hiroshima University Hospital and its affiliated hospitals. A control group was also included and consisted of a random sample of non-endoscopist physicians.

Questionnaire

The questionnaire for endoscopists consisted of questions on the endoscope model primarily used, mean number of endoscopic examinations and treatments per week, mean amount of time spent performing endoscopic procedures per week, location and description of pain present at the time of the survey, impact of pain on the endoscopist, type of treatment needed for the pain, and injury prevention strategies currently in place, if any. Non-identifying demographic information including age, sex, body mass index (BMI), hand dominance, physical activity level, and practice years was obtained. A modified survey was sent to the non-endoscopists.

Statistical analysis

Student *t*-tests were performed to evaluate differences in weight, height, and BMI between the groups. χ^2 tests were used to assess variables including age, sex, hand dominance, physical activity level, and practice years. To identify the factors associated with musculoskeletal pain,

Table 1 Non-endoscopist physicians who participated in this survey

	<i>n</i> (%)
Internist	65 (54)
Surgeon	17 (14)
Dermatologist	10 (8)
Psychiatrist	7 (6)
Radiologist	4 (3)
Resident	4 (3)
Pathologist	3 (3)
Pediatrician	1 (1)
Orthopedic surgeon	1 (1)
Gynecologist	1 (1)
Emergency physician	1 (1)
NI	6 (5)
Total	120 (100)

NI: Not informed.

Table 2 Subject characteristics

Characteristics	Endoscopists (<i>n</i> = 190)	Non-endoscopists (<i>n</i> = 120)	<i>P</i> value
Age (yr, mean \pm SD)	41.4 \pm 6.7	40.1 \pm 7.6	0.202
Years in practice (yr, mean \pm SD)	16.2 \pm 8.1	14.8 \pm 9.4	0.083
Sex			0.197
Male/female	164/26	97/23	
Dominant hand			0.077
Right/left/NI	179/9/2	108/12/0	
Activity level			0.046
Mild	131 (69%)	70 (58%)	
Moderate	50 (26%)	43 (36%)	
Remarkable	5 (3%)	5 (4%)	
NI	4 (2%)	4 (3%)	
Height (cm)	168.6 \pm 6.9	168.1 \pm 7.0	0.202
Weight (kg)	66.3 \pm 10.6	64.9 \pm 11.3	0.287
Body mass index (kg/m ²)	23.2 \pm 2.2	22.8 \pm 3.0	0.306

NI: Not informed.

Table 3 Number of endoscopic procedures completed per week (mean \pm SD)

Procedure type	No. per week
Esophagogastroduodenoscopy (<i>n</i> = 190)	15.0 \pm 8.7
Colonoscopy (<i>n</i> = 161)	6.7 \pm 3.7
Endoscopic retrograde cholangiopancreatography (<i>n</i> = 63)	2.1 \pm 1.8
Endoscopic ultrasonography (<i>n</i> = 48)	2.2 \pm 1.9

especially pain in the hand and wrist among endoscopists, univariate and multivariate logistic regression analyses were performed with JMP IN (Cary, NC, USA) software. All significance levels were set at $P < 0.05$.

RESULTS

Subject characteristics

questionnaires were sent to 275 endoscopists and 173 non-endoscopist physicians. One hundred ninety (69%) endoscopists and 120 (69%) non-endoscopists returned

Table 4 Environmental factors affecting endoscopic procedures

Factor	No. per week (<i>n</i> = 190)
Use of height-adjustable examination table (yes/no)	186 (98)/4 (2)
Position of monitor (directly in front of endoscopist, at eye level/other position)	133 (70)/57 (30)
Manufacturer of endoscope primarily used (Olympus/Fujifilm/NI)	138 (73)/47 (25)/5 (3)

NI: Not informed.

completed questionnaires. The details of non-endoscopist physicians who participated in this survey are shown in Table 1. The two groups were similar in terms of age, years in practice, sex, hand dominance, and BMI (Table 2). Physical activity level was significantly lower in endoscopists than in non-endoscopists ($P = 0.046$).

Endoscopy information

The number of esophagogastroduodenoscopies completed per week was 15.0 ± 8.7 (mean \pm SD) (Table 3). Of the 190 endoscopists, 161 (85%) performed colonoscopies, and the mean number of colonoscopies performed per week was 6.7 ± 3.7 (mean \pm SD). Sixty-three (33%) endoscopists performed endoscopic retrograde cholangiopancreatography (ERCP). Forty-eight (25%) endoscopists performed endoscopic ultrasonography (EUS). On average, the amount of time spent per week performing endoscopy was 11.9 ± 8.7 h (mean \pm SD).

Environmental factors affecting endoscopic procedures

Most (98%) endoscopists indicated that they used height-adjustable examination tables (Table 4). As for monitor position, 133 of 190 (70%) endoscopists replied that the monitor was directly in front of the endoscopist and at eye level. With regard to the manufacturer of the endoscope used, 138 (73%) endoscopists used Olympus, 47 (25%) used Fujifilm, and 5 (3%) gave no response.

Musculoskeletal pain in endoscopists

None of the endoscopists reported a history of preexisting musculoskeletal conditions. Eighty-one (43%) endoscopists had musculoskeletal pain at the time of the survey, and 21 (26%) of those reporting pain sought medical care as a consequence.

The most frequent sites of pain identified by the endoscopists were the lower back ($n = 50$, 26%), the neck ($n = 18$, 9%), the right shoulder ($n = 18$, 9%), and the left thumb ($n = 16$, 8%) (Table 5). Pain in the hand and wrist was reported by 32 (17%) endoscopists.

Musculoskeletal pain in non-endoscopists

None of the non-endoscopists reported a history of preexisting musculoskeletal conditions. Forty-nine (41%) non-endoscopists reported musculoskeletal pain at the time of the survey, and 7 (14%) of these physicians sought medical care as a consequence.

The most frequent sites of pain identified in the non-endoscopists were the lower back ($n = 24$, 20%), the right shoulder ($n = 14$, 12%), the neck ($n = 13$, 11%), and the left shoulder ($n = 12$, 10%) (Table 5). Pain in the hand and wrist was reported by 7 (6%) non-endoscopists.

Comparison of musculoskeletal pain between endoscopists and non-endoscopists

The frequency of overall musculoskeletal pain did not differ significantly between the endoscopists and non-endoscopists (81 of 190 (43%) *vs* 49 of 120 (41%), $P = 0.755$). However, the frequency of pain in the left thumb was significantly higher in the endoscopists than in the non-endoscopists (16 of 190 (8%) *vs* 0 of 120 (0%), $P = 0.001$). Pain in the hand and wrist was significantly higher in the endoscopists than in the non-endoscopists (32 of 190 (17%) *vs* 7 of 120 (6%), $P = 0.004$). There were no significant differences between the groups in the frequency of pain at other locations, such as the shoulder and lower back.

Univariate and multivariate logistic regression analyses for factors associated with thumb, finger, hand, and wrist pain in endoscopists

Results of univariate analysis for factors related to thumb, finger, hand, and wrist pain in endoscopists are shown in Table 6. The only significant factor was age of the endoscopist (> 40 years *vs* ≤ 40 years, $P = 0.011$). The mean number of colonoscopies per week and dominant hand tended to be significant (> 6.7 *vs* ≤ 6.7 , $P = 0.091$, left *vs* right, $P = 0.098$, respectively). Thus, endoscopists who performed more than 6.7 colonoscopies per week or who were left-handed tended to have more frequent pain in the hand and wrist.

Results of multivariate analysis for factors related to pain in the hand and wrist in endoscopists are shown in Table 7. Only age was found to be a significant factor associated with pain in endoscopists (> 40 years *vs* ≤ 40 years, odds ratio (OR) 2.77, 95% confidence interval, 1.23-6.71, $P = 0.018$) by multivariate analysis.

Pain prevention

Only 23 (12%) endoscopists had made modifications to their endoscopic practice in response to pain arising due to performing endoscopic procedures. The most common practice modifications endorsed are shown in Table 7. These modifications were stretching exercises ($n = 11$, 6%), taking breaks ($n = 11$, 6%), wearing athletic shoes ($n = 8$, 4%), and less work ($n = 5$, 3%). Interestingly, endoscopists had made significantly fewer modifications to their practice than non-endoscopists to address pain prevention.

Requests to improve endoscopic design from endoscopists

The requests made by Japanese endoscopists to improve endoscope design are shown in Table 8. The most frequent request was to make the operating part lighter ($n = 85$, 45%), followed by making the operating part

Table 5 Frequency of major types of musculoskeletal pain in Japanese endoscopists and non-endoscopists *n* (%)

Site of pain	Endoscopists (<i>n</i> = 190)	Non-endoscopists (<i>n</i> = 120)	<i>P</i> value
Neck (present/absent)	18 (9)/172 (91)	13 (11)/107 (89)	0.698
Right shoulder (present/absent)	18 (9)/172 (91)	14 (12)/106 (88)	0.536
Left shoulder (present/absent)	15 (8)/175 (92)	12 (10)/108 (90)	0.522
Right wrist (present/absent)	3 (2)/187 (98)	1 (1)/119 (99)	0.571
Left wrist (present/absent)	13 (7)/177 (93)	4 (3)/116 (97)	0.186
Right thumb (present/absent)	3 (2)/187 (98)	0 (0)/120 (100)	0.167
Left thumb (present/absent)	16 (8)/174 (92)	0 (0)/120 (100)	0.001
Right hand/fingers (present/absent)	5 (3)/185 (97)	1 (1)/119 (99)	0.263
Left hand/fingers (present/absent)	4 (2)/186 (98)	1 (1)/119 (99)	0.387
Lower back (present/absent)	50 (26)/140 (74)	24 (20)/96 (80)	0.204
Hand and wrist (present/absent)	32 (17)/158 (83)	7 (6)/113 (94)	0.004
Total (present/absent)	81 (43)/109 (57)	49 (41)/71 (59)	0.755

Table 6 Univariate analysis of factors associated with pain in the hand and wrist in endoscopists

Characteristics	<i>P</i> value
Age (> 40 yr <i>vs</i> < 40 yr)	0.011
Sex (male <i>vs</i> female)	0.378
Dominant hand (left <i>vs</i> right)	0.098
Activity level (moderate/remarkable <i>vs</i> mild)	0.338
Height (> 168 cm <i>vs</i> < 168 cm)	0.796
Weight (> 66 kg <i>vs</i> < 66 kg)	0.642
Body mass index (> 25 kg/m ² <i>vs</i> < 25 kg/m ²)	0.61
Mean number of esophagogastroduodenoscopies per wk (> 15 <i>vs</i> < 15)	0.215
Mean number of colonoscopies per wk (> 6.7 <i>vs</i> < 6.7)	0.091
Do ERCP (yes <i>vs</i> no)	0.871
Do EUS (yes <i>vs</i> no)	0.969
Mean time performing endoscopic procedures per week (> 12 h <i>vs</i> < 6.7 h)	0.636
Use of height-adjustable examination table (no <i>vs</i> yes)	0.836
Position of monitor (other position <i>vs</i> directly in front of endoscopist, at eye level)	0.8
Manufacturer of endoscope primarily used (fujifilm <i>vs</i> olympus)	0.28

ERCP: Endoscopic retrograde cholangiopancreatography; EUS: Endoscopic ultrasonography.

smaller (*n* = 41, 22%), and reducing the resistance of the angulation controller (*n* = 36, 19%). There were no significant differences between the frequency of requests and the manufacturers of the endoscope primarily used (data not shown).

DISCUSSION

Our data indicate that the frequency of pain in the hand and wrist, and especially in the left thumb, was significantly higher in endoscopists than non-endoscopists (17% *vs* 6%, *P* = 0.004). By multivariate analysis, the only significant factor associated with pain was the age of the endoscopist (OR 2.77, *P* = 0.018).

Previous studies have reported that the incidence of symptoms or injuries attributable to the performance of endoscopy ranges from 39% to 78%^[11]. These results suggest that musculoskeletal pain is prevalent in

Table 7 Modifications to prevent musculoskeletal pain

Modification	Endoscopists (<i>n</i> = 190)	Non-endoscopists (<i>n</i> = 120)	<i>P</i> value
No modifications	167 (88)	80 (67)	< 0.0001
Stretching exercises	11 (6)	26 (22)	< 0.0001
Taking breaks	11 (6)	8 (7)	0.754
Wearing athletic shoes	8 (4)	6 (5)	0.744
Less work	5 (3)	1 (1)	0.263

Table 8 Requests to improve endoscopic design from endoscopists *n* (%)

Request	No. of endoscopists (<i>n</i> = 190)
Make the operating part heavier/lighter	0 (0)/85 (45)
Make the operating part larger/smaller	1 (1)/41 (22)
Make the angulation controller larger/smaller	15 (8)/27 (14)
Make the resistance of the angulation controller heavier/lighter	0 (0)/36 (19)

endoscopists. In the present study, 43% of endoscopists had musculoskeletal pain, which is similar to that in previous reports. In addition, a U.S. study showed that the frequency of reported musculoskeletal pain was higher in endoscopists than non-endoscopists (74% *vs* 35%, *P* < 0.001)^[10]. In the present study, pain in the hand and wrist was significantly more frequent in endoscopists than in non-endoscopists, indicating that endoscopists may be at higher risk for musculoskeletal pain, especially in the hand and wrist, than non-endoscopists.

The most frequent sites of pain reported in our study were the lower back, neck, right shoulder, and left thumb. Previous studies have reported similar anatomic sites of pain associated with performing endoscopy, including a case report of de Quervain's syndrome or "endoscopists' thumb"^[11-14]. Buschbacher^[15] found that 27% of responders reported low back pain, 19% thumb pain, and 19% shoulder pain. Preliminary results from an American Society for Gastrointestinal Endoscopy web-based survey found that 43% reported hand or carpal tunnel injuries, 29% reported back pain, and 28%

reported neck pain^[16]. Specific aspects of performing endoscopy which may contribute to musculoskeletal pain are as follows: adjusting the tip of angulation controls, torquing with the right hand, and standing for prolonged periods of time. Manipulation of the tip angulation controls and torquing of the endoscope may lead to hand and wrist pain, whereas standing for prolonged periods of time may lead to back and neck pain.

In the present study, only age of the endoscopist was significantly associated with pain. Several researchers reported that age did not have an impact on the musculoskeletal pain identified. However, the location of pain has been reported to be different between a beginner group (duration of practicing endoscopy, < 39 mo) and an experienced group^[11]. The left thumb and fingers were the most common painful areas in beginners (43%), whereas the left shoulder was most painful in experienced endoscopists (33%). Furthermore, older age and sex were associated with many musculoskeletal disorders^[17]. Age may be an important factor associated with the musculoskeletal pain reported by endoscopists.

ERCP and EUS are both procedures requiring long endoscopy times with special devices. Some may think that these procedures are more likely to lead to musculoskeletal pain than other procedures. However, in the present study, performance of these procedures was not a significant factor associated with pain, whereas the mean number of colonoscopies performed per week and dominant hand tended to be significant by univariate analysis. In other words, the performance of colonoscopy may be a risk factor for the development of pain in the hand and wrist rather than the performance of ERCP or EUS. The torquing technique is very important in the performance of colonoscopy, and it is done frequently and for long periods of time. Furthermore, colonoscopy may require stronger torquing power than any other procedures, including ERCP and EUS. Therefore, torquing of the colonoscope appears to be another risk factor associated with pain. The colonoscope is torqued with the right hand, which is the weaker hand for left-handed endoscopists, and it is plausible that left-handed endoscopists tend to have more pain in the hand and wrist than right-handed endoscopists. A larger study is needed to investigate this issue.

Methods to prevent back pain include the use of a height-adjustable examination table, rubberized floor mats, and a short foot stool to alternate weight distribution^[18]. Monitor placement is an especially important determinant of torso and head posture. Monitors should be placed directly in front of the endoscopist while in the working position to avoid rotation and flexion of the cervical spine and should be adjusted to eye level^[18]. Most (98%) responders in the present study reported use of an adjustable examination table. However, 30% of responders reported that the position of monitors was inadequate. None of the endoscopists used rubberized floor mats or a short foot stool. There is much room for improvement in relation to these factors.

Improving posture, increasing physical activity, and stretching exercises before endoscopy have been suggested to prevent disability^[18]. Interestingly, in the present study, endoscopists made significantly fewer modifications to their endoscopic practices to prevent musculoskeletal pain, especially in regard to performing stretching exercises, than non-endoscopists. The reason for this is unknown. One possibility is that Japanese endoscopists may be busier than other non-endoscopist physicians and may not have enough time or willingness to exercise or stretch. Of course, selection bias may be undeniable. Education on methods to reduce endoscopic-related injuries must be carried out in a positive manner.

Endoscopic techniques that can help to prevent pain include minimizing torque and having an assistant apply torque when necessary. Ultimately, reevaluating the design of the endoscope with regard to ergonomics may be the best long-term strategy to reduce overuse injuries in an era of high-volume endoscopy. Endoscopists in the present study requested a lighter and smaller operating part and reduced resistance of the angulation controller. These requests may be useful for improving the design of the endoscope.

In conclusion, our data suggest that pain in the hand and wrist may be endoscopy-related. However, endoscopists made few modifications to their practices to prevent pain. More attention to pain prevention appears to be needed. Given the importance of endoscopy in the clinical setting, our results support a further controlled study on this subject in a much larger and more diverse population of endoscopists.

COMMENTS

Background

It has been suggested that the performance of endoscopy predisposes the operator to the development of musculoskeletal pain.

Research frontiers

There is little published evidence of this, especially from Eastern countries including Japan.

Innovations and breakthroughs

Frequency of occurrence of pain in the hand and wrist, and especially the left thumb, was significantly higher in endoscopists than in non-endoscopists (17% vs 6%, $P = 0.004$). By multivariate analysis, the only significant factor associated with the pain was the age of the endoscopist (odds ratio 2.77, 95% confidence interval, 1.23-6.71, $P = 0.018$).

Applications

The authors' data suggest that pain in the hand and wrist may be endoscopy-related. More attention toward pain prevention appears necessary.

Peer review

This is a study on an important issue, musculoskeletal pain in endoscopists. As authors described, more attention toward pain prevention in endoscopists should be paid.

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