

## Prevalence of Musculoskeletal Disorders

---

Rose Moss, MN, RN, CNOR  
Perioperative Nurse Consultant/Medical Writer  
Moss Enterprises, LLC  
Westcliffe, CO

### **Prevalence of Musculoskeletal Disorders: Impact of Hand Fatigue on Surgeon Efficiency and Performance**

Ergonomics is one of the most critical issues challenging surgeons today, as problems occur during both open and minimally invasive surgical (MIS) procedures.<sup>1</sup> The adverse ergonomic effects for surgeons who repeatedly perform laparoscopic procedures have become more widely appreciated over the years,<sup>2</sup> as the majority of laparoscopic surgeons report suffering from work-related physical symptoms or injuries.<sup>3</sup> Moreover, evidence from simulation studies has shown that an optimal ergonomic practice environment results in better task performance during laparoscopic surgery.<sup>4</sup>

The rise in the prevalence of work-related musculoskeletal disorders (MSDs) in surgeons performing laparoscopic procedures is generally due to insufficient ergonomic considerations of the MIS operating environment.<sup>5</sup> During MIS procedures, poor ergonomic modification of surgical instrumentation, as well as the operating room (OR) itself, can lead to the development of MSDs, resulting in pain.<sup>6</sup> Another factor related to ergonomic injuries inherent to the OR practice environment is hand fatigue; in this regard, the demanding, tedious, and/or repetitive actions required of all surgical techniques increase the susceptibility of the muscles, nerves, and tendons in the hands, wrists and arms to strain, which can be aggravated by wearing gloves that are thick, rigid, slippery, ill-fitting or uncomfortable.<sup>7</sup>

A recent meta-analysis reported that prevalence estimates of work-related MSDs among at-risk physicians in procedural specialties (eg, surgeons) appear to be high - approaching epidemic status - relative to the impending workforce shortage; therefore, it is vital that ergonomic strategies designed to prevent these disorders are developed, validated, and implemented.<sup>8</sup> This article examines the prevalence of general MSDs, with a focus on finger- and hand-related incidences in the surgical field and their impact on a surgeon's efficiency and performance. The use of ergonomic gloves, as a solution to minimize muscle effort and reduce the risk of injury, will also be reviewed.

### *General MSDs: Statistics and Clinical Data*

There is growing interest in understanding the impact that operating has on a surgeon's body;<sup>9</sup> as a result, surveys describing the prevalence of general MSDs in surgeons are reported in the medical literature.

- Recently, a survey of minimally invasive surgeons across multiple surgical specialties conducted by Gutierrez-Diez, et al reported that:<sup>10</sup>
  - The prevalence of MSDs is greater in MIS surgeons than in any other occupational group.
  - Of the 129 surgeons interviewed, 90% reported MSD symptoms in at least one part of their body; a higher prevalence existed in the most experienced surgeons.
  - The short term effects of MSDs cause pain, discomfort, and physical fatigue, along with adversely affecting their performance of surgery.
  - In the long-term, MSDs reduce surgeons' efficiency when performing surgical procedures.
  - According to the authors of this study:

“...the results of the survey also show that surgeons have a great sense of responsibility, resulting in a tendency to remain working while accepting pain as a natural consequence of their work.”<sup>11, p.3</sup>

- Catanzarite, et al, conducted a comprehensive literature review related to the prevalence of work-related MSDs and unique ergonomic risks and considerations in various types of surgical procedures; their results for laparoscopic and robotic-assisted surgery are as follows:<sup>12</sup>
  - Traditional laparoscopy: 73% to 100% MSDs rate; risks include position of the table and monitor, use of long-shafted instruments, and poor design of the instrument handles.
  - Robotic-assisted surgery: 23% to 80% MSDs rate; robotic surgery is associated with some advantages, however, it is correlated with strain of the trunk, wrist, and fingers.

The authors also note that surgeon work-related MSDs frequently result in disability, but they are often underreported to healthcare facilities.

*Clinical Data Specific to Hand Fatigue, Carpal Tunnel Syndrome, and Hand-Related MSDs*

Several studies have examined MSDs specific to finger- and hand-related incidences among surgeons.

- In the survey conducted by Gutierrez-Diez, et al noted above, over 90% of surgeons who regularly perform MIS procedures experienced MSDs over a 3 month period, with 28% of the reported MSD incidences being specific to their right hand.<sup>13</sup>
- An earlier survey by Plerhoples, et al found that between 5.3% and 17.8% of 1,215 surgeons who performed open, robotic, and laparoscopic surgeries reported physical discomfort of either their thumb or fingers.<sup>14</sup>
- In a similar study of plastic surgeons and other surgical specialists, research by Capone, et al observed an 81.5% rate of MSD symptoms among survey respondents and a 15.1% rate of carpal tunnel syndrome.<sup>15</sup> In this survey, 73% of the respondents (n=236) identified themselves as plastic surgeons; 17.7% of the reported plastic surgeons observed symptoms of carpal tunnel syndrome.
- Research by Gofrit, et al supports the conclusion that the laparoscopic operating theater is a hostile ergonomic environment.<sup>16</sup> This survey was conducted on 73 urologists; the typical respondent was 44 years old, had completed an average of 117 procedures, and was performing 3 laparoscopic surgeries weekly. The survey results showed that 45% of the surgeons reported hand and wrist numbness after performing hand-assisted laparoscopic surgeries (HALS) and 37% reported pain in these areas; 30% of the 73 urologists surveyed reported neuromuscular or arthritic symptoms during surgery, with the most common reported symptom being finger paresthesia at 18%.
- A recent survey of laparoscopic clinicians conducted by Shepherd, et al found that females using a glove size of 6.5 or smaller (versus males and a glove size of 7 or larger) had a greater frequency of moderate to severe hand and wrist symptoms in short procedures; this trend was also observed for long procedures, but was not statistically significant.<sup>17</sup> In addition, experience (5 years or less) was associated with more severe and cumulative instrument-related symptoms.
- Dabholkar, et al reported that both experienced and novice surgeons adopted awkward wrist postures during simulated laparoscopic cholecystectomy.<sup>18</sup>
- A study by Koca, et al examined surgeons' mental workload and fatigue in the fingers, hands, arms, and shoulders in both single-incision laparoscopic surgery (SILS) and multiport laparoscopy.<sup>19</sup> Their results demonstrated that the surgeons in the SILS group took longer to complete laparoscopic tasks; the reduction in finger- and hand-strength was similar in both SILS and standard laparoscopy.

### *The Role of Ergonomic Surgical Gloves in Preventing MSDs and Improving Performance*

Today, advancements in surgical glove technology and design have led to the development of ergonomically-designed gloves that offer a solution for addressing hand fatigue and reducing the risk for MSDs. This type of glove is produced by measuring the stresses of occupational activities and then applying advanced technologies to engineer solutions that alleviate muscle effort, strain, and tension, while maximizing the dexterity, comfort, and fit of single-use gloves; as a result, the gloves support musculoskeletal health when performing repetitive tasks and also improves worker performance.

For example, exertion measurements and comparisons are based on specific tasks, such as flexion of the hand; pinch grasp, ie, holding a common instrument; or grip friction, ie, completion of a precise, standard task. These measurements are then evaluated in two ways:

1. Conducting controlled user surveys that evaluate their experience as well as comfort, both before and after tasks are conducted. The survey criteria may include various aspects such as fit, comfort, performance, tactile sensitivity, the ability to appropriately don the glove, and gripping ability.
2. Taking electromyography measurements that quantify the amount of muscle effort exerted by individual muscles in the hand during the assigned tasks.

After the measurement data are collected, they are analyzed to determine how glove performance compares to data collected in bare-hand operations and also those taken while wearing comparable products. Based on these results, gloves that deliver measurable improvements in user comfort, fit, and productivity while reducing the risk factors associated with ergonomic injury can be designed. Over time, the use of ergonomically designed gloves may result in less downtime and fewer injuries, and subsequently, more consistent levels of both quality and productivity.

### *Summary*

Reports in the medical literature demonstrate that work-related MSDs are prevalent - approaching epidemic status - among surgeons today, despite often being underreported; as a result, there is increasing interest in understanding the physical implications of performing surgery. Specifically, MIS techniques and the effects of hand fatigue have been shown to adversely impact both the efficiency and performance of a surgeon; therefore, implementation of effective ergonomic practices is warranted. One ergonomic strategy for reducing muscle effort, supporting occupational hand health, and optimizing performance and productivity, is the use of high-performing, ergonomically designed surgical gloves.

## References

- <sup>1</sup> Glickson J. Surgeons experience more ergonomic stress in the OR. <http://bulletin.facs.org/2012/04/surgeons-experience-more-ergonomic-stress-in-the-or/#.WlaHDzcVhPZ>. Accessed January 15, 2018.
- <sup>2</sup> Plerhoples TA, Hernandez-Boussard T, Wren SM. The aching surgeon: a survey of physical discomfort and symptoms following open, laparoscopic, and robotic surgery. *J Robot Surg*. 2012;6(1):65-72.
- <sup>3</sup> Park A, Lee G, Seagull FJ, Meenaghan N, Dexter D. Patients benefit while surgeons suffer: an impending epidemic. *J Am Coll Surg*. 2010; 210(3):306–313.
- <sup>4</sup> Xiao DJ, Jakimowicz JJ, Albayrak A, Goossens RH. Ergonomic factors on task performance in laparoscopic surgery training. *Appl Ergon*. 2012;43(3):548-553.
- <sup>5</sup> Dabholkar TY, Yardi SS, Oak SN, Ramchandani S. Objective ergonomic risk assessment of wrist and spine with motion analysis technique during simulated laparoscopic cholecystectomy in experienced and novice surgeons. *J Minim Access Surg*. 2017;13(2):124-130.
- <sup>6</sup> Gutierrez-Diez MC, Benito-Gonzalez MA, Sancibrian R, Gandarillas-Gonzalez MA, Redondo-Figuero C, Manuel-Palazuelos JC. A study of the prevalence of musculoskeletal disorders in surgeons performing minimally invasive surgery. *Int J Occup Saf Ergon*. 2018;24(1):111-117. doi: 10.1080/10803548.2017.1337682. Epub 2017 Sep 15.
- <sup>7</sup> Ansell. White Paper: Supporting worker performance & productivity with ergonomic glove design. [https://www.hagemeyerna.com/HagemeyerNA/media/Documents/Ergonomic\\_Whitepaper\\_Final.pdf](https://www.hagemeyerna.com/HagemeyerNA/media/Documents/Ergonomic_Whitepaper_Final.pdf). Accessed January 15, 2018.
- <sup>8</sup> Epstein S, Sparer EH, Tran BN, et al. Prevalence of work-related musculoskeletal disorders among surgeons and interventionalists: a systematic review and meta-analysis. *JAMA Surg*. 2017 Dec 27:e174947. doi: 10.1001/jamasurg.2017.4947.
- <sup>9</sup> Plerhoples TA, Hernandez-Boussard T, Wren SM. The aching surgeon: a survey of physical discomfort and symptoms following open, laparoscopic, and robotic surgery. *J Robot Surg*. 2012;6(1):65-72.
- <sup>10</sup> Gutierrez-Diez MC, Benito-Gonzalez MA, Sancibrian R, Gandarillas-Gonzalez MA, Redondo-Figuero C, Manuel-Palazuelos JC. A study of the prevalence of musculoskeletal disorders in surgeons performing minimally invasive surgery. *Int J Occup Saf Ergon*. 2018;24(1):111-117. doi: 10.1080/10803548.2017.1337682. Epub 2017 Sep 15.

- 
- <sup>11</sup> Gutierrez-Diez MC, Benito-Gonzalez MA, Sancibrian R, Gandarillas-Gonzalez MA, Redondo-Figuero C, Manuel-Palazuelos JC. A study of the prevalence of musculoskeletal disorders in surgeons performing minimally invasive surgery. *Int J Occup Saf Ergon*. 2018;24(1):111-117. doi: 10.1080/10803548.2017.1337682. Epub 2017 Sep 15.
- <sup>12</sup> Catanzarite T, Tan-Kim J, Whitcomb EL, Menefee S. Ergonomics in surgery: a review. *Female Pelvic Med Reconstr Surg*. 2018;24(1):1-12.
- <sup>13</sup> Gutierrez-Diez MC, Benito-Gonzalez MA, Sancibrian R, Gandarillas-Gonzalez MA, Redondo-Figuero C, Manuel-Palazuelos JC. A study of the prevalence of musculoskeletal disorders in surgeons performing minimally invasive surgery. *Int J Occup Saf Ergon*. 2018;24(1):111-117. doi: 10.1080/10803548.2017.1337682. Epub 2017 Sep 15.
- <sup>14</sup> Plerhoples TA, Hernandez-Boussard T, Wren SM. The aching surgeon: a survey of physical discomfort and symptoms following open, laparoscopic, and robotic surgery. *J Robot Surg*. 2012;6(1):65-72.
- <sup>15</sup> Capone AC, Parikh PM, Gatti ME, Davidson BJ, Davison SP. Occupational injury in plastic surgeons. *Plast Reconstr Surg*. 2010;125(5):1555-1561.
- <sup>16</sup> Gofrit ON, Mikahail AA, Zorn KC, Zagaja GP, Steinberg GD, Shalhav AL. Surgeons' perceptions and injuries during and after urologic laparoscopic surgery. *Urology*. 2008;71(3):404-407.
- <sup>17</sup> Shepherd JM, Harilingam MR, Hamade A. Ergonomics in laparoscopic surgery--a survey of symptoms and contributing factors. *Surg Laparosc Endosc Percutan Tech*. 2016;26(1):72-77.
- <sup>18</sup> Dabholkar TY, Yardi SS, Oak SN, Ramchandani S. Objective ergonomic risk assessment of wrist and spine with motion analysis technique during simulated laparoscopic cholecystectomy in experienced and novice surgeons. *J Minim Access Surg*. 2017;13(2):124-130.
- <sup>19</sup> Koca D, Yıldız S, Soyupek F, et al. Physical and mental workload in single-incision laparoscopic surgery and conventional laparoscopy. *Surg Innov*. 2015;22(3):294-302.
- <sup>20</sup> Ansell. White Paper: Supporting worker performance & productivity with ergonomic glove design. [https://www.hagemeyerna.com/HagemeyerNA/media/Documents/Ergonomic\\_Whitepaper\\_Final.pdf](https://www.hagemeyerna.com/HagemeyerNA/media/Documents/Ergonomic_Whitepaper_Final.pdf). Accessed January 15, 2018.

---

Disclaimer: Moss Enterprises has performed paid consulting work for Ansell and/or its affiliates. Rose Moss, MN, RN, CNOR works with Moss Enterprises.

Ansell Healthcare Products LLC  
111 Wood Avenue, Suite 210  
Iselin, NJ 08830 USA

Ansell Healthcare Europe NV  
Riverside Business Park  
Blvd International, 55,  
1070 Brussels, Belgium

Ansell Limited  
Level 3, 678 Victoria Street,  
Richmond, Vic, 3121  
Australia

Ansell Services (Asia) Sdn. Bhd.  
Prima 6, Prima Avenue,  
Block 3512, Jalan Teknokrat 6  
63000 Cyberjaya, Malaysia