Applied Ergonomics 60 (2017) 334–341

Contents lists available at ScienceDirect

Applied Ergonomics

journal homepage: www.elsevier.com/locate/apergo

The impact of intraoperative microbreaks with exercises on surgeons: A multi-center cohort study

M.S. Hallbeck [a, b, c, *], B.R. Lowndes [a, b], J. Bingener [c], A.M. Abdelrahman [a, b], D. Yu [a, b], A. Bartley [b], A.E. Park [d, e]

[a] Mayo Clinic's Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery, Rochester, MN, United States
[b] Department of Health Sciences Research, Mayo Clinic, Rochester, MN, United States
[c] Department of Surgery, Mayo Clinic, Rochester, MN, United States
[d] Department of Surgery, Anne Arundel Medical Center, Annapolis, MD, United States
[e] Johns Hopkins University School of Medicine, Johns Hopkins, Baltimore, MD, United States

ARTICLE INFO

Article history:
Received 10 May 2016
Received in revised form
7 December 2016
Accepted 12 December 2016
Available online 29 December 2016

Keywords:
Microbreaks
Surgery
Physical and mental performance

ABSTRACT

Recent literature has demonstrated ergonomic risk to surgeons in the operating room. One method used in other industries to mitigate these ergonomic risks is the incorporation of microbreaks. Thus, intraoperative microbreaks with exercises in a non-crossover design were studied. Fifty-six attending surgeons from 4 Medical Centers volunteered first in a day of their regular surgeries and then second day where there were microbreaks with exercises that could be performed in the sterile field, answering questions after each case, without significantly increasing the duration of their surgeries. Surgeons self-reported improvement or no change in their mental focus (88%) and physical performance (100%) for the surgical day incorporating microbreaks with exercises. Discomfort in the shoulders was significantly reduced while distractions and flow impact was minimal. Eighty-seven percent of the surgeons wanted to incorporate the microbreaks with exercises into their OR routine. Intraoperative microbreaks with exercises may be a way to mitigate work-related musculoskeletal fatigue, pain and injury.

1. Introduction

Many aspects of surgery have not changed in the 100 years since Gilbreth observed it – there are still extreme postures with high force exertion for long durations, while performing at a high level of accuracy and reliability (Gilbreth, 1916). Sir Alfred Cuschieri started talking about the tribulations of minimally invasive surgery over 20 years ago (Cuschieri, 1995). This is still a problem, as demonstrated in recent publications by surgeons using the phrases such as, "impending epidemic" (Park et al., 2010); "hostile environment" (Sari et al., 2010); and "hurting Docs" (Berguer, 2013). Despite these findings, pain and discomfort in surgeons is still a problem illustrated by several studies reporting from 60% (Sari et al., 2010; Plerhoples et al., 2012) to nearly 90% (Park et al., 2010; Kim-Fine et al., 2013; Cavanagh et al., 2012; Davis et al., 2014; Abdelrahman et al., 2016; Szeto et al., 2009; Sivak-Callcott et al., 2011; Sivak-Callcott et al., 2015) of surgeon respondents experiencing pain/discomfort during or after performing minimally invasive, gynecological, orthopedic and pediatric surgery. A likely contributor to the reported musculoskeletal symptoms (Berguer, 1998; Berguer et al., 1999; Trejo et al., 2006; Tung et al., 2015) is the cumulative exposure to ergonomic limitations of the surgical, especially the MIS workplace (Berguer, 1998; Berguer et al., 1998; Nguyen et al., 2001; Matern et al., 2004; Park et al., 2010; Youssef et al., 2011; Sutton and Park, 2012; Craven et al., 2013; Lowndes and Hallbeck, 2014; van Veelen et al., 2004; Van Veelen and Meijer, 1999; Stomberg et al., 2010; 7Miller et al., 2012).

The risk factors for the pain/discomfort are awkward postures, static positions, high force exertion and long periods of working time without breaks (Punnett and Wegman, 2004; Reyes et al., 2006; Abdelrahman et al., 2016). There are surgeons who receive surgery themselves or must stop performing surgery due to work-acquired musculoskeletal disorders, and therefore threatening patient access. For example, in one study, 22% of surgeons reported missing work days with an average of 7 days/surgeon/injury, 35% reported performing fewer procedures after their injury (Davis et al., 2014), and in another study, an estimated 9% of surveyed MIS surgeons have been stopped practicing due to musculoskeletal

* Corresponding author. Mayo Clinic, 200 First Street SW, Rochester, MN 55905, United States.
E-mail address: Hallbeck.susan@mayo.edu (M.S. Hallbeck).

http://dx.doi.org/10.1016/j.apergo.2016.12.006

pain (Sivak-Callcott et al., 2011; Sivak-Callcott et al., 2015). Surgeons experience a range of work-related injuries that affect nerves in the arm and hand, cause rotator cuff overuse injuries, and damage cervical joints (Gofrit et al., 2008), including a cumulative disorder called laparoscopists' thumb (Kano et al., 1995; Majeed et al., 1993). However, there are few reports of occupational injuries prevalence due to the lack of institutional reporting by the surgeons (Davis et al., 2014). There are a number of reasons for surgeons' lack of reporting, including acceptance of pain and discomfort as the "cost of the job" and acceptance of the poor ergonomic working conditions for the sake of their patients where "the needs of the patient come first".

Surgeons, despite limited knowledge of ergonomics (Park et al., 2010), try to alleviate pain during surgery. The most commonly employed method is changing positions; however, this strategy is not effective enough due to room and instrument constraints (Albayrak et al., 2007; Berguer, 1998; Berguer et al., 1999; Matern and Waller, 1999; Trejo et al., 2006), and a significant percentage of surgeons must ameliorate symptoms by spreading out or decreasing caseloads (Davis et al., 2014). In some cases, surgeons are forced to stop offering advanced life-saving surgical techniques or choose to perform open surgeries rather than MIS because of pain (Plerhoples et al., 2012). These options threaten patient access to surgery (Diller et al., 2013) and significantly increase patient recovery time (McCrory et al., 2014). This fact highlights a growing problem: surgeon work-related injury and the resulting loss in productivity are increasing while demand from patients for advanced complex life-saving surgical procedures is growing (Franasiak et al., 2012; Davis et al., 2013; Davis et al., 2014; Leigh, 2011). The high mental and physical workloads in the operating room (OR), in combination with long hours with little time for recovery, can lead to work-related musculoskeletal disorders for the surgeon (Punnett and Wegman, 2004; Reyes et al., 2006). The act of performing surgery may actually be doing harm to the highly trained surgeon (Davis et al., 2014), and failure to address intraoperative ergonomic risk factors will have a measurable reduction of patient safety and patient access (Diller et al., 2013; Niven, 2002).

Gilbreth (1916) advocated for standardization of surgical equipment and the hospital environment and recommended scheduled rest periods and using technology to avoid fatigue arising from necessary work. However, the surgeon's load has increased due to advances in technology (Rodrigues et al., 2012), increased surgical complexity, as well as an increase in medical team members in the OR (Lowndes and Hallbeck, 2014) and Gilbreth's recommended scheduled rest periods have yet to be adopted (Gilbreth, 1916).

There are data from non-surgical fields demonstrating that breaks or rest allowances are important to reduce stress and strain for various tasks. In these industries, microbreaks-short breaks more than once/hour-typically ~1-min every 20–30 min, as well as longer breaks of 5–9 min between activities, have been shown to reduce fatigue (Bennett, 2015; Galinsky et al., 2000, 2007). In a recent systematic review, exercise and rest breaks were found to reduce musculoskeletal discomfort for computer tasks (Barredo and Mahon, 2007), which supports OSHA recommendations of stretching throughout the day, taking several short rest breaks, alternating tasks and making small adjustments in workstation. Another systematic review found that rest breaks were found to have limited positive benefits industrially, but microbreaks with exercise were found to have a moderate positive impact on upper extremity musculoskeletal disorder outcomes (Van Eerd et al., 2015).

Two preliminary studies have shown that intraoperative microbreaks can be translated to the surgical environment. The first is a small surgical study (16 surgeons) that showed that 20-s breaks every 20 min over the 2 + hour surgery were beneficial (Dorion and Darveau, 2013). The matched surgeries with and without microbreaks demonstrated that the microbreak condition with neck and shoulder stretch compared to control (prior to surgery) was associated with significant reduction in subjective and objective fatigue. Their microbreak trial data showed fatigue of those participants without the microbreaks was double of those with the microbreaks after 2 h and with microbreaks, body part discomfort in the neck, back, shoulder, wrists and elbows was significantly lower. The most dramatic finding was for accuracy of a star-tracing test with a Metzenbaum scissor which yielded an average 7-fold increase in error for "typical" non-microbreak surgeries compared with the microbreak surgeries in their study (Dorion and Darveau, 2013). A second study on 53 surgeries showed that a microbreak with 5 min of exercise every 30 min did not increase the length of surgery (Engelmann et al., 2011); in addition, it reduced salivary stress hormones, lowered the increase in fatigue and stress for the group with breaks compared to those without. These studies demonstrate that microbreaks have potential to reduce fatigue, discomfort and stress and improve performance without increasing the length of surgeries.

The surgeon's operative discomfort/fatigue/pain can reduce accuracy and other surgical performance measures (Davis et al., 2014). Work-related musculoskeletal disorders may also impair the performance of the surgeon and subsequently patient safety (Park et al., 2010; Sari et al., 2010). Long-term, the cumulative traumas to the body from long, difficult surgical procedures can shorten the career of the surgeon (Harvin, 2014; Sivak-Callcott et al., 2011). The current study will 1) gather baseline data on prevalence and impact (including quality of life) of musculoskeletal pain and discomfort and 2) will examine the influence of intraoperative microbreaks with exercise for surgeons on their subjective physical performance mental focus, and self-reported pain/discomfort across multiple institutions, surgical procedures and surgeons in order to improve provider health and patient safety.

2. Material and methods

2.1. Participants

Sixty-one surgeons at 4 Medical Centers (Mayo Clinic, Anne Arundel Medical Center, Carolinas Medical Center and University of Louisville School of Medicine) were invited to participate in the study approved by the respective IRB boards. Participants were all attending surgeons in general, pediatric, orthopedic, neurosurgery, urology, otorhinolaryngology (ENT), gynecology, plastics, thoracic and vascular surgery. Over the four sites, 56 attending surgeons completed both the operative control days and the microbreaks with exercise intervention days of the study, while performing their regularly scheduled surgeries.

2.2. Materials and equipment

Prior to the operative days studied, each surgeon was required to complete a preliminary questionnaire compiled from excerpts from previous questionnaires by Park et al. (2010), Plerhoples et al. (2012), the Brief Pain Inventory (BPI) (Cleeland and Ryan, 1994; Keller et al., 2004) and the Nordic Musculo-Skeletal Questionnaire (NMSQ) (Kuorinka et al., 1987). This preliminary questionnaire covered self-reported body part discomfort, impact on surgery of work-related body part discomfort, what the surgeon did to mitigate this discomfort, if they felt the pain would impact their ability to perform their job and their level of pain in the past 24 h after surgery with how that pain impacted their sleep and relations with others. This questionnaire also had demographic information.