Differences in postural loading between primary and assistant surgeons during vaginal surgery


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Article info
Article history:
Received 20 April 2017
Received in revised form 12 October 2017
Accepted 8 January 2018

Keywords:
Awkward postures
Surgery
Musculoskeletal discomfort
Vaginal surgeon

Abstract
While increasing attention has been given to the prevalence of work-related musculoskeletal disorders (WMDs) among surgeons in various medical specialties, there is no quantitative information about the potential work-related risk factors that contribute to WMDs among vaginal surgeons in the operating room (OR). This study aimed to quantify the frequency and duration of awkward postures, as well as musculoskeletal discomfort experienced by primary and assistant vaginal surgeons during surgery in order to provide a first step of informing ergonomics interventions that reduce postural loading during surgery. Thirteen primary and 14 assistant surgeons were evaluated during 13 surgical cases. Surgeon pre- and post-operative musculoskeletal discomfort ratings were collected with surveys. During surgery, real-time observations systematically characterized the frequency and duration of awkward neck, trunk and shoulder postures using tablet-based ergonomics software. Surgeons experienced postoperative increases in musculoskeletal discomfort of the neck, wrists, hands, back and feet. Assistant surgeons experienced greater right and left shoulder discomfort than primary surgeons (p < .05 and p < .034). The frequencies and durations of observed awkward postures were high for both primary and assistant surgeons. Assistant surgeons spent twice as long in trunk flexion than the primary surgeons. These results suggest that the postural loading experienced by assistant vaginal surgeons is for some postures higher than that of primary surgeons, and that ergonomics interventions aimed at reducing the frequency of neck, shoulder and trunk postures during surgery could potentially benefit vaginal surgeons. Relevance to industry: Surgeons provide a valuable healthcare service to the public, but surgeons are at high risk of musculoskeletal problems due to their work demands. This study provides new information about the physical requirements of vaginal surgeries to inform ergonomics interventions that prevent work-related musculoskeletal disorders among primary and assistant surgeons.

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1. Introduction

Becoming a qualified surgeon requires years of rigorous education, training, and practice, and the demand for surgeons will increase significantly over the next decade (BLS, 2017). Unfortunately, surgeons are exposed to work-related musculoskeletal disorder (WMD) risk factors while in the operating room that include maintaining awkward body postures, precision work, high workload, fatiguing job tasks, and psychosocial stress (Berguer, 1999; Hengel et al., 2011; Houvet and Obert, 2013; Tírgar et al., 2013; Szeto et al., 2009, 2010, 2012). These risk factors can lead to reductions in productivity, quality of working life and potentially early retirement, decreasing the availability of qualified surgeons needed to meet growing occupational demands (Berguer, 1996; Kranenburg and Gossot, 2004; Simonsen et al., 2012). Patient safety may also be compromised if surgeons’ competencies are reduced when working while injured (Arora et al., 2010; Mache et al., 2012; Liu et al., 2004; Yu et al., 2016).

https://doi.org/10.1016/j.ergon.2018.01.003
0169-8141/© 2018 Published by Elsevier B.V.
Vaginal surgery includes those operations performed directly through the vagina, offering restoration of distorted anatomy and reconstruction through a minimally invasive natural orifice (Lees and Singer, 1987; Nichols and Randall, 1996). Considering the high degree of patient safety and the cost-effectiveness of the procedures, the vaginal approach is one of the widely selected for hysterectomies (Kim-Fine et al., 2013a; Occhino and Gebhart, 2010). It is less invasive than abdominal surgery and costs less than laparoscopic surgery (Kim-Fine et al., 2013a). The American College of Obstetrics and Gynecology in a committee opinion recommends the vaginal hysterectomy as the approach of choice when feasible due to well-documented advantages and lower complications (ACOG, 2005). However, the orientation of multiple surgeons with respect to the small surgical field, and the physical requirements of the procedure can make the postural demands of surgery very challenging for the vaginal surgeon (Fig. 1).

While there are dozens of ergonomics studies that have evaluated ergonomics problems and interventions for minimally invasive surgeries such as laparoscopic surgery, only two studies have been published to date that focus specifically on the ergonomics challenges experienced by surgeons during vaginal surgery. These studies examined only the prevalence of musculoskeletal problems among vaginal surgeons (Dolan and Martin, 2001; Kim-Fine et al., 2013b), and neither provided job-related information designed to improve ergonomics during surgery. Both cross-sectional surveys described subjective self-reported musculoskeletal discomfort. One study confirmed that a majority (87%) of vaginal surgeons experienced pain in their neck, back and lower extremities at least once a week (Kim-Fine et al., 2013b). The other reported 72% of gynecologists in Northern Ireland experienced significant backache, with 54% attributing the pain to performing vaginal surgery (Dolan and Martin, 2001). These problems can impact the surgeon’s productivity and earning potential. Musculoskeletal discomfort negatively impacted work behavior in 48% of vaginal surgeons, causing 14% to miss work and the remaining to modify work hours or surgery schedules (Kim-Fine et al., 2013b).

In many types of surgery, the order of surgical tasks and the frequency and duration of each surgical task’s occurrence are determined by the goals of the surgery, the patient’s physical condition and surgeon’s procedural preferences and skill sets (Paraiso et al., 2011). Even surgeries involving the same set of surgical tasks can differ from patient to patient in terms of the sequence of surgical tasks and the frequency and duration of these tasks (Paraiso et al., 2011; Yu et al., 2016).

Such sources of exposure variability make collection of exposure information across multiple surgeries, over longer rather than shorter periods, and across multiple surgeons very important for a reliable assessment of exposures (Paquet et al., 2005). Our aim was to evaluate the degree of subjective discomfort vaginal surgeons experience due to surgical work, and provide a preliminary estimate of the frequency and duration of awkward body postures required of assistant and primary vaginal surgeons during surgery. Based on experiences in the operating room, the surgeons who participated in the design and implementation of the study (LYK, CI, RG, AS and AP) believed that assistant surgeons were required to hold awkward trunk, shoulder and neck postures more frequently and for greater durations. In meetings with the other co-authors (XZ and VP), the team agreed that such differences in postural requirements could possibly lead to differences in muscular discomfort between assistant and primary surgeons. We therefore hypothesized that assistant surgeons would experience greater muscle discomfort after surgery and higher postural loading during surgery when compared to primary vaginal surgeons.

2. Methods

This was an IRB approved cross-sectional study that evaluated the body postures and associated musculoskeletal discomfort of primary and assistant surgeons during vaginal hysterectomy ± concomitant procedures. There are short procedures that occur through the vagina such as diagnostic hysteroscopies where a camera is placed into the uterus for evaluation, dilation and curettage where a sample of the uterus is taken to determine causes for abnormal or postmenopausal bleeding, and other procedures that involve anatomic problems of the vagina such as urethral diverticulum or gartner ducts cyst. Longer procedures through the vagina include vaginal hysterectomies, pelvic reconstructive surgeries, and fistula repairs. We chose a procedure that was both commonly performed through the vagina and was long enough to allow us to assess the musculoskeletal strain that vaginal surgeons experience during a common but longer vaginal procedure.

Surgeons and patients were consented for participation in the study prior to surgery. Surgeons were from the same medical group affiliation and performed surgeries at one of two hospitals. All operating rooms were similarly equipped. Surgeon demographics included prior musculoskeletal injury and treatment, surgical volume and type of surgery performed (e.g. vaginal, laparoscopic, robotic, or open), post-graduate training level, age, physical activity, gender, BMI, and dominant hand were captured via questionnaires. Primary and assistant vaginal surgeons greater than 18 years of age and able to complete questionnaires were included. Pregnant surgeons and surgeons whose patients declined participation were excluded. A surgeon could serve as either primary or assistant during the case, and would remain in this role until the completion of the case. If appropriate in a subsequent case, the surgeon could change roles and participate in the new role (a primary surgeon in one case could be an assistant surgeon in another). If an attending surgeon was an assistant and needed to take over the case for patient safety for a brief period of time, the surgeon’s postures during the role change was excluded from the analysis.

Surgeons rated body part discomfort pre- and post-operatively using the Body Part Discomfort Interview BORP-CR 10 along with a pictorial diagram. The Borg-CR 10 is a scale of 0, no discomfort, to 10, severe discomfort, with 1 point increments (Borg, 1998; Grant et al., 1999). A trained team of 4 researchers collected the field observations of awkward postures experienced by surgeons during

Fig. 1. Primary (middle) and assistant (sides) surgeons performing vaginal surgery.
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