Effect of chair types on work-related musculoskeletal discomfort during vaginal surgery

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BACKGROUND: Evidence supports that surgeons are at high risk for work-related musculoskeletal disorders.

OBJECTIVE: The objective of the study was to compare the effect of different chairs on work-related musculoskeletal discomfort for surgeons during vaginal operations.

STUDY DESIGN: This crossover study randomly assigned 4 surgeons to 4 chair types using a 4 × 4 Latin square model: a conventional round stool, a round stool with a backrest, a saddle chair with a backrest, and a Capisco chair. Subjective assessments of surgeon discomfort were performed with a validated body discomfort survey, and workload was assessed with the surgical task load index. The objective postural load was quantified with inertial measurement units of the modified rapid upper limb assessment limits. Subjective and objective assessments of chair comfort were performed with an 11 point scale and seat interface pressure—mapped distributions, respectively. The primary outcome was the difference in body discomfort scores between pre- and postsurgery measurements. Secondary outcomes were the differences in chair comfort scores, postural load, and seating interface pressure—mapped distribution. For each outcome, comparisons among the chair types were based on fitting a linear mixed model that handled the surgeon as a random effect and the chair type as a fixed effect.

RESULTS: Data were collected for 48 vaginal procedures performed for pelvic organ prolapse. Mean (SD) duration of surgery was 122.3 (25.1) minutes. Surgeons reported body discomfort during 31 procedures (67.4%). Subjective increase in discomfort from the preoperative state was noted most commonly in the lower back (n = 14, 30.4%), followed by right shoulder (n = 12, 26.1%), upper back (n = 8, 17.4%), hips and buttocks (n = 7, 15.2%), left shoulder (n = 6, 13.0%), right or left thigh (n = 6, 13.0%), and neck (n = 6, 13.0%). Pre- and postsurgery body discomfort scores did not differ with respect to chair type. Chair discomfort scores for the round stool and the saddle chair were significantly higher than the round stool with backrest and the Capisco chair ($P < .001$). Although the average modified rapid upper limb assessment postural scores showed moderate to high musculoskeletal risk of neck and shoulder discomfort across the 4 surgeons; chair type did not affect postural scores. The saddle chair had significantly reduced dispersion of seated pressure vs the round stool with backrest ($P \leq .001$), depicted by the number of cells with pressure values >5 mm Hg. An increased dispersion of pressure across the chair surface was associated with increased comfort (Spearman correlation, 0.40, $P = .006$).

CONCLUSION: Musculoskeletal strain and associated discomfort for surgeons are very high during vaginal operations. Chair type can affect comfort, and chairs with more uniform distribution and fewer pressure points are more comfortable. However, the chair type used in surgery did not influence the musculoskeletal postural load findings.

Key words: chairs, ergonomics, musculoskeletal discomfort, vaginal surgery

Surgeons work in a high-performance environment that demands both physical and mental endurance.[1] The increasing emphasis on patient safety, along with the tremendous cost of preventable adverse events in health care, has made the job of the surgeon further challenging.[2] To adapt to the new challenges, surgeons have subjected themselves to work in poor ergonomic conditions for long periods in the operating room. The resulting fatigue and discomfort may impair their concentration and jeopardize their performance and thereby affect patient safety.[3-5] A nonergonomic work environment also may result in occupational injuries to surgeons that may affect their career longevity.

Evidence supports that surgeons are at high risk for work-related musculoskeletal disorders. About 88% of surgeons and gynecologists who perform minimally invasive procedures have reported discomfort or pain after performing an operation.[6,7]

In a survey-based study, Matern and Koneczny[8] reported that 97% of surgeons expressed the need for ergonomic improvements in the operating room. With the prediction of a worsening shortage of surgeons in the United States, as well as an aging surgeon workforce, surgeons may be required to perform operations until older ages.[9] These predictions further emphasize the need for strategies to improve the working environment for surgeons and help minimize occupational injuries.

Despite the extensive prevalence of musculoskeletal disorders among surgeons, the overall awareness of ergonomic techniques in operating rooms is low.[6] The literature of evaluated ergonomic issues in obstetrics and gynecology is further limited.[7,10-16] In gynecological surgery, the vaginal route is a traditional approach and involves working in a constrained space and in unfavorable postures for long durations. A survey of gynecological surgeons showed that 86.7% of surgeons performing vaginal surgery experienced work-related musculoskeletal discomfort.[14]

In addition, performance of vaginal operations was the leading cause of backache among gynecologists.[15] Zhu et al[10] objectively measured and quantified postural load of surgeons during

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FIGURE 1
The 4 different chair types used in the study

A, Round stool. **B,** Round stool with backrest. **C,** Saddle chair with backrest. **D,** Capisco chair.

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vaginal procedures and reported it to be great, especially during vaginal hysterectomy.

We assessed the magnitude of musculoskeletal disorders among gynecologists who perform vaginal surgery and compared the effect of different chair types on work-related musculoskeletal discomfort and load during a procedure.

Materials and Methods

This crossover study randomly assigned 4 gynecologists to use 4 chair types while performing vaginal procedures for pelvic organ prolapse. The chairs studied were the round stool, the round stool with a backrest, the saddle chair with a backrest,[17] and the Capisco chair (Figure 1). The 4 types were randomly assigned to the surgeons using 3 separate 4 × 4 Latin squares. This strategy allowed us to block on surgeon and chair order and to have 3 replications per surgeon-chair combination.

Measurements

Demographic data collected for the participants included age, body mass index, years of surgical experience, handedness, previous injury or illness, average number of surgical operations performed per month, and percentage of time spent performing vaginal or abdominal procedures. The physical activity of an individual surgeon was assessed using the validated World Health Organization Global Physical Activity Questionnaire.[18]

Each surgeon completed a presurgery questionnaire before procedure initiation. This step included a validated tool, the Cornell Musculoskeletal Discomfort Questionnaire,[19] to assess the baseline discomfort status of the surgeon. Before surgery, pressure mats with pressure sensors were placed on the seat pan of each chair. We recorded body postures and movements in the operating room using inertial measurement units (12M, SXT version; APDM, Inc, Portland, OR)[20]

Four inertial measurement units were attached to each surgeon's body at the forehead, at the upper chest, and on bilateral arms above the elbows. Immediately after the procedures, the surgeons were asked to complete the first postsurgery questionnaire. The surgeons completed the second postsurgery questionnaire the day after the recorded surgery.

The first postsurgery questionnaire asked details of the surgery, including procedure type, duration, an 11 point visual analog scale assessment of comfort of the chair and chair seat pan, the Surgical Task Load Index[21] (to measure the surgical workload), and the modified musculoskeletal discomfort questionnaire (Cornell Musculoskeletal Discomfort Questionnaire).[19]

The Surgical Task Load Index index[21] is a validated tool that measures surgery-specific workload. The second postsurgery questionnaire included the Cornell Musculoskeletal Discomfort Questionnaire.[19]

When the surgeon performed >1 vaginal hysterectomy in a day, only the first case was included in the study. Similarly, when the surgeon performed a vaginal procedure for prolapse on 2 consecutive days, the procedure performed on the second day was not included. This inclusion strategy allowed for a washout period between the interventions and increased the study's internal validity. When the surgeon performed a vaginal procedure on 2 consecutive days, the surgeon was asked to complete the postsurgery questionnaire early the second day before the upcoming procedure.

The primary outcome was the difference between the pre- and postsurgery Cornell Musculoskeletal Discomfort Questionnaire ratings that provided a subjective assessment of surgeon